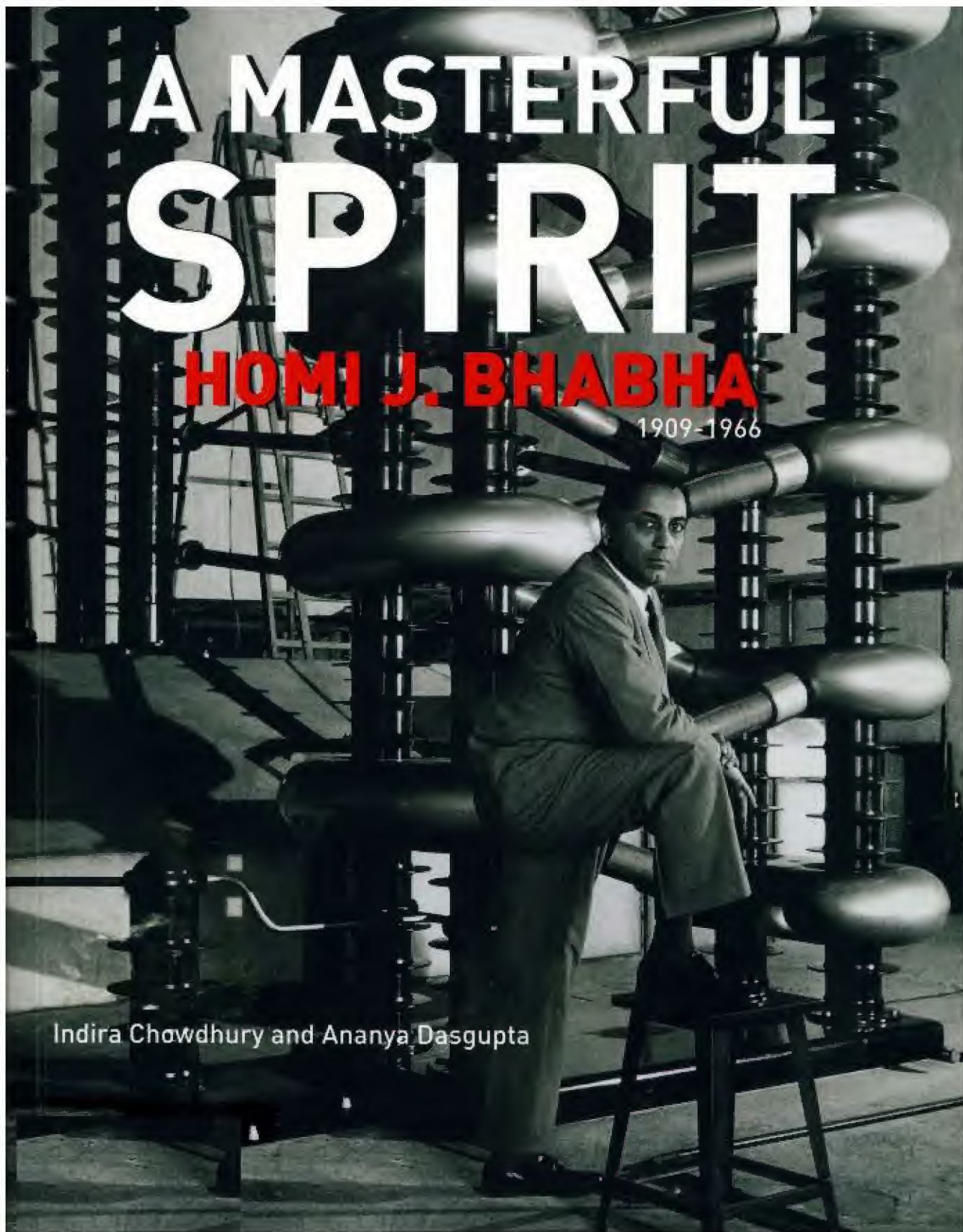


A MASTERFUL SPIRIT

HOMI J. BHABHA

1909-1966

Indira Chowdhury and Ananya Dasgupta



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HOMI J. BHABHA 1909–1966

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PENGUIN BOOKS

CONTENTS



1	THE HOUSE ON LITTLE GIBBS ROAD	06
2	THE EARLY YEARS	16
3	CAMBRIDGE AND THE ROMANCE WITH PHYSICS	26
4	THE PLEASURES OF EXILE	50
5	JEH AND RUS	88
6	AN INSTITUTE IS BORN	102
7	DEAR BHAI	152
8	THE ATOMIC KINGDOM	162
9	HOMI'S OTHER WORLD	198
10	A WORLD WITHOUT HOMI BHABHA	236
	<i>A Note from the Authors</i>	254
	<i>Design Note</i>	257
	<i>Copyright Acknowledgements</i>	258
	<i>About the Authors</i>	260

1. THE HOUSE ON LITTLE GIBBS ROAD

23/1/43
To Mr. H. J. Pheasant
12 Little Gibbs Rd,
Malabar Hill,
Bombay.

HOMI BHABHA IS BORN IN BOMBAY 1919 HALLEY'S COMET APPEARS

1911 | RUTHERFORD DISCOVERS THE STRUCTURE OF THE ATOM | WILSON DEVELOPS THE 'CLOUD CHAMBER'

'In his letters to his family as well as in his talks with his intimate friends, he used to refer with gratitude to the exceptionally close bonds of affection and understanding that knit together the members of his family and to which he attributed a sense of emotional security in his formative years.'

Sir John Cockcroft, 'A Tribute to Homi Jehangir Bhabha', London, 20 January 1967.

MEHRANGIR
LITTLE GIBBS ROAD,
MALABAR HILL,
BOMBAY.

The House on
Little Gibbs Road

The child born to Jehangir and Meherbai Bhabha on 30 October 1909 was called Homi by the family. Hormasji Jehangir Bhabha, for that was his full name, was named after his grandfather, Hormasji Bhabha, the Inspector of General Education in the princely state of Mysore in India. Homi's father, Jehangir Bhabha, had grown up in Bangalore and was educated at Oxford. He trained as a lawyer in England, and like his father, Hormasji, had started his working life in Mysore, joining the judicial service of the state. He had married Meherbai, the daughter of Ruttonbai and Framji Dorabji Panday of Bombay. After their marriage, the couple had moved to Bombay.

181

Their house had a massive library with books that belonged to Hormasji, Jehangir and Meherbai. There was a garden to relax in and dogs to play with. As their younger son, Jamshed Bhabha would recall many years later: 'My mother and father were very happily married and very close to each other. So the whole environment was happy, which is very important when you're small.' Later when the Bhabhas built their home on Little Gibbs Road, Malabar Hill, Bombay, it was their son Homi who had named the house 'Mehrangir' – a combination of the names of Meherbai and Jehangir. After the death of his father, Homi would write movingly to Wolfgang Pauli and Birbal Sahni about the deep bonds of affection he shared with his parents.



The Bhabha family portrait bears testimony to the profound social transformations that took place in the early twentieth century: the style of dressing became westernized and traditional forms of family life made way for the modern, nuclear family. The Bhabha family close-knit as it was, however, remained in touch with the larger extended family, which included the Pandays, the Petits and the Tatas.

The House on
Little Glos Road



140



It was Bhabha's mother Meherbai, home maker and nurturer, who remained the central force. Bhabha's attachment to his mother was legendary. After his father's death, he unfailingly took her on a vacation every summer.

Previous Page: Jhanganji Bhabha, Meherbai, Jamsheo and Homi, c. 1910s

Top: Bhabha family c. 1920s

Left: Bhabha with his mother, Meherbai, c. 1940s

'Even in her later years, Meherbai, always decked out in a white silk sari and lacy Victorian blouse, strands of pearls and diamonds and fashionable pointy-toed, fine leather shoes, the likes of which one never saw in Bombay, would entertain guests in her gorgeous drawing room, filled with works of art from their travels in Europe.'

Roshan Rivetna, Homi Bhabha's second cousin.



The House on
Little Gibbs Road

Jamshed Jehangir Bhabha (1914-2007), younger brother of Homi Jehangir Bhabha. A Cambridge graduate with a Historical Tripos, Jamshed Bhabha was unable to take the Bar Finals at Lincoln's Inn when World War II broke out in 1939. He returned to India and joined Tata Steel. Like his brother, Homi, he was deeply interested in music and the arts and was the founder of the National Centre for the Performing Arts in Mumbai.

I am the younger brother to Dr Homi Bhabha. Homi and I were extremely close to each other – in fact, we were more than brothers. When we were small, he was almost like a second father to me. He was a wonderful man. And he was a wonderful draughtsman. He also painted, and so did I – but his drawings are masterly. Then we had my mother and father – very happily married – very close to each other. My mother's name was Meherbai or Mehri. The whole environment was happy, which is very important when you're small. It is very important to be brought up in an atmosphere free of anxiety, strain and hostility. Therefore, I consider myself very fortunate to have had such a wonderful environment. We had also doggies and they were very lovely.

We also had a relationship with music. My aunt Cooverbai had a wonderful collection of 78 rpm records, which you had to turn over. Homi, our cousin Dinshu and I would take turns at winding the gramophone and turning over the record. And we were

all *chup!* No disturbance of the continuity of the music – we were absolutely *chup!* We knew the symphonies of Beethoven when we were tiny.

Mrs Scylla Vatcha (b. 1923), married Rustom Vatcha and was a relative of Homi Bhabha. She recollects an amusing incident that happened during World War I.

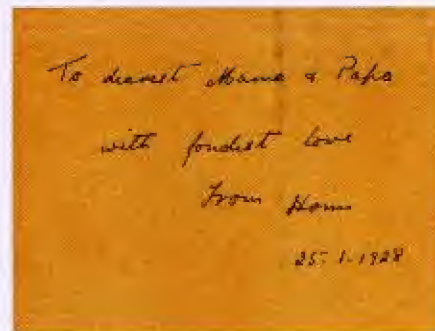
My mother-in-law, Mrs Navajbai Sorabji Vatcha (daughter of Cowasji Dorabji Panday) and Homi's mother Mrs Meherbai Jehangir Bhabha (daughter of Framji Dorabji Panday) were first cousins and their young children – my husband Rustom (Navajbai's son) and Homi and Jamshed (Meherbai's sons) were often together in the sprawling eighteen-room Panday home at Tardeo, where their grandfathers Framji Dorabji Panday and his brother Cowasji Dorabji Panday lived.

There are several stories we all knew in the family and I shall recount some of them here. As a young child Homi hardly slept and this bothered his parents no end. Once while on a trip to Europe, they heard of a very famous child specialist in Paris. They took an appointment with the child specialist and the child was taken in for a consultation. After a while, the nurse came out and informed all the other patients that their appointments had been cancelled as the doctor wanted to spend more time with the Bhabha child. The parents became very anxious. After a while, they were called in and the doctor told them that that he was most

fascinated by the child. He said that the child had an extraordinarily active brain which was ticking away all the time, and hence the child could not sleep. Almost prophetically, he told the parents that they needed only to create good surroundings for him and take care of his physical needs; he would grow up to be a genius.

As boys, Homi and my husband Rustom spent a lot of time together at the Kenilworth bungalow on Pedder Road. The bungalow belonged to their mutual aunts Bachubai and Hirabai, and later, to their other aunt, Cooverbai Panday. Around the time of the First World War, Homi heard of parachutes. Homi, then was only about six or seven years old, and keen to try out anything new, including jumping down with a 'parachute'. So he and Rustom, who was a few months younger, stood on the ledge of a first floor balcony of Kenilworth holding two umbrellas, ready to jump. Their older cousin Dinshaw Panday caught them in the nick of time and pulled them back!

The Bhabha home behind the Hanging Gardens on Malabar Hill had been designed by Homi himself. It was called 'Mehrangir' – after the names of his parents, Meherbai and Jehangir. It was a beautiful home and Meherbai would hold elegant parties with interesting guests. Homi was a remarkably talented painter and did a portrait of his mother Meherbai, wearing an intricately embroidered Chinese gara sari. This is a painting I have seen. He had reproduced all the details to



A note from Homi to his parents from Cambridge, 1928. This is inscribed behind a photograph included on page 36.

perfection in the portrait. It hung on the wall, at the head of the dining room wall of their bungalow 'Mehrangir' on Little Gibbs Road. Meherbai wore a Mona Lisa smile in the portrait and her cousins often teased her that it was for her favourite and adored son, Homi.

Roshan Rivetna (b. 1939), Homi Bhabha's second cousin, was close to the Bhabha family and regarded Homi Bhabha as a role model. She worked as a Research Associate at the Tata Institute of Fundamental Research. She moved to the USA in 1966. She is actively involved with the Zoroastrian Community.

Homi Bhabha grew up, and lived to the end, with his loving mother, Meherbai Bhabha (his father had passed away earlier) on the upper floor of the palatial three-storey family mansion behind the Hanging Gardens in Bombay. An avid gardener as well, he was an expert on trees, plants and flowers, and experimented with exotic plants, cross-bred bougainvillea and roses on his

The House on
Little Gibbs Road

terrace garden, overlooking a breath-taking view of the city. Even in her later years, Meherbai, always decked out in a white silk sari and lacy Victorian blouse, strands of pearls and diamonds and fashionable pointy-toed, fine leather shoes, the likes of which one never saw in Bombay, would entertain guests in her gorgeous drawing room, filled with works of art from their travels in Europe. When the British Royal family visited Bombay in the 1950s, Prince Philip, the Duke of Edinburgh was a dinner guest at the Bhabha home and was served *khichree* and *sas-ni-machhi*, made by Meherbai's longtime cook.

Homi Sethna (b. 1923), chairman of the Atomic Energy Commission from 1972 to 1983, knew the Bhabha family personally. Here he recollects details about Homi Bhabha's relationship with his mother.

Homi Bhabha's mother Meherbai was a real lady. She was a person who epitomized all that is noble. She was very free with people whom she liked. She was a very gracious lady. Bhabha spoke to her mainly in Gujarati – sometimes in English. He used to use a mixture of the two. He had to see her before he left for office every day. He also had a miniature French poodle that he liked very much. I think he was called Cupid.

This early photograph of Homi Bhabha dated 1913 was taken when he visited Bad Kissingen, a spa town in Bavaria with his parents. The photograph was inscribed to 'Bo-Papa', probably his paternal grandfather, and signed 'from Homi Baba'.



To Bo-Papa
From Baba
With best love.
April 1913
Kissinger

With love + kisses
Homi Baba

2. THE EARLY YEARS

'The Cathedral High School did much to foster a love for science in me. One's school years are often the most formative ones and I remember enjoying my school days very much.'

Homi Bhabha to C.H. Hammond, former Headmaster of Cathedral School, Bombay,
14 October 1955.

In 1916 when Homi started school, the shadow of the Great War still loomed large. As the War progressed and poets like Wilfred Owen wrote of the waste of human life at the front, the young Homi led a sheltered life. But the imaginative five year old Homi was captivated by parachutes – which had been put to military use for the first time during World War I. Homi and his cousin, Rustom, attempted to imitate paratroopers; holding their umbrellas, they prepared to jump off the first floor balcony – the two boys were pulled back in the nick of time by their cousin Dinshaw Panday.

Like most wealthy Parsi families in India, the Bhabha family was very westernized. The language at home was mainly English. But Homi often spoke to his mother in the musical Gujarati typically used by Parsis. He was also familiar with the popular Parsi rhymes of his time. As his brother Jamshed recalled, like many Parsi youngsters they knew the familiar ditty:

"I am Parsi Driver 'GIP'
Going to Platform No. 3
Up to Station Chinchpockli."

They sang such songs just for fun; as entertainment. For the boys belonged to a privileged world, far removed from the world of the Parsi engine driver. Besides, Homi showed an early interest in solving problems and taking on practical challenges. He loved playing with the metal strips of his Meccano set, using the wheels, the gears and the clamps to build and rebuild models of cars and cranes. Perhaps this was where it all began – his interest in science, his curiosity about how things worked.

Homi went to the Cathedral Boys School in Bombay where he learnt Latin and French, developed a great fondness for the poetry of Shelley and above all discovered his deep interest in science. He sketched and painted and gained a mastery over both as he trained with the artist Jehangir Lalkaka. He also spent a considerable amount of time listening to music on the gramophone. His mother's sister, Cooverbai Panday lived on Pedder Road; in fact, she occupied Kenilworth, a bungalow where Homi Bhabha was born. Handicapped and unable to move independently, Cooverbai had a keen ear for music and a splendid collection of gramophone records. Along with his brother Jamshed and his cousin, Dinshaw, Homi spent long hours listening to music at his aunt's house. Three boys at the gramophone, taking turns to wind it up; turning the record over when one side had finished playing, in absolute, intoxicated silence. By the time he was eight, young Homi knew the symphonies and concertos of Beethoven, Verdi, Mozart and Wagner. He also learnt to play the violin. In fact, the love for music was so deeply ingrained in him from an early age that as a young man he would take every opportunity to go to concerts in Europe and in India.

As a young boy he spent time at the home of his father's sister, his aunt, Meherbai. Mehri, as she was affectionately called by her family, was married to Dorabji Tata, the elder son of the pioneer of Indian industry

Jamsetji Tata. There at Esplanade House, where two huge terracotta dogs flanked the doorway, and where the waters of the Arabian Sea lapped the boundary walls, the young Homi spent many an afternoon. His aunt did not have children of her own and was very fond of the boys. Her distinguished husband had been knighted in 1910. After the death of his father, Jamsetji Tata in 1904, Dorab had thrown himself energetically into organizing the family business. It was his vision and management skills that enabled the entire enterprise to grow from three cotton mills and the Taj Mahal Hotel in Mumbai into India's largest private sector company with a steel company, three electric companies and one of India's leading insurance companies.

It was at Sir Dorab's house that young Homi witnessed the emerging world of Indian industry. But more significantly, he experienced the exhilaration of a fledgling nation's yearning for independence as he caught glimpses of leaders like Gandhi and Nehru at his uncle's house. Even if the alliance that was being forged between industrialists and politicians within the anti-colonial movement eluded the young Homi, he heard them speak and plan for a new, independent India. The impact of their words was to remain with him all his life.

By the time he took his Senior Cambridge examination, Homi had read Einstein's special theory of relativity – a theory that had turned notions of measurement upside down and wiped out the idea that space, time and mass are absolute quantities. For young Homi, the theory opened up a new understanding of the world, which in itself was not surprising

42	
WINNERS OF OPEN PRIZES.	
GOVERNOR'S PRIZE.	
Imperial History and Geography.	
1920 W. J. WHITE.	1923 W. HODGSON.
1921 N. LEONTHOS.	1924 A. KATTAN.
1922 S. KHARABATTA.	
HEADMASTER'S PRIZE.	
English Essay.	
1920 W. J. WHITE.	1922 A. SPILLER.
1921 N. LEONTHOS.	1923 S. KHARABATTA.
1922 N. LEONTHOS.	1924 H. J. BRADHA.
HUDSON PRIZE.	
History.	
1920 J. B. HODGSON.	1922 A. SPILLER.
1921 N. LEONTHOS.	1923 A. KATTAN.
1922 N. LEONTHOS.	1924 A. KATTAN.
Old Boy's Prize.	
Swims.	
1920 J. MURCHILL.	1923 K. TALSARKHAN.
1921 W. SLOAN.	1924 A. KATTAN.
HUDSON PRIZE.	
Mathematics.	
1920 J. B. HODGSON.	1922 M. MARSA.
1921 N. LEONTHOS.	1923 E. TALLYANDAN.
1922 N. LEONTHOS.	1924 H. J. BRADHA.
FLOWER PRIZE.	
Latin.	
1924 A. KATTAN.	
SCHOOL PRIZE.	
General Knowledge.	
1924 (Senior) S. K. PACE.	1924 (Junior) E. A. UNDERDOWN.

43	
CATHEDRAL & JOHN CONDON BOYS' SCHOOL.	
First Prize for General Proficiency—	
Standard I. H. OGDON.	Standard V. E. ANDER.
" II. P. RAJES.	" VI. A. VAN.
Standard III. H. DOR.	" VII. I. SARMA.
" IV. G. G. G. G.	" VIII. A. KATTAN.
" V. A. G. G. G.	" IX. H. THOMAS.
" VI. A. G. G. G.	" X. A. G. G. G.
Mathematics Prize—	
Standard I. H. OGDON.	Standard V. E. ANDER.
" II. P. RAJES.	" VI. A. VAN.
" III. H. DOR.	" VII. I. SARMA.
" IV. G. G. G. G.	" VIII. A. KATTAN.
" V. A. G. G. G.	" IX. H. THOMAS.
" VI. A. G. G. G.	" X. A. G. G. G.
Scripture Prize—	
Standard I. H. OGDON.	Standard V. E. ANDER.
" II. P. RAJES.	" VI. A. VAN.
" III. H. DOR.	" VII. I. SARMA.
" IV. G. G. G. G.	" VIII. A. KATTAN.
" V. A. G. G. G.	" IX. H. THOMAS.
" VI. A. G. G. G.	" X. A. G. G. G.
Special Merit—	
K. DOR.	M. MARSA.
A. KATTAN.	A. VAN.
Clear Prize (Presented by Mr. HODGSON)—	
Senior Class Boys.	" W. SLOAN.
Junior Class Boys.	" S. K. PACE.
Special Prize.	" For punctuality and regular attendance.

MURCHILL, J. M.	Passed in Religious Knowledge, Geography, Latin, Mathematics, History, Physical Sciences, H. Hodgson.
THOMAS, H.	Passed in Religious Knowledge, English, Geography, Latin, Mathematics, History.
VAN, A.	Passed in Religious Knowledge, English, English History, Geography, Latin, Mathematics.
GIRLS.	
ANDER, E.	Passed in Religious Knowledge, English, English History, Geography, French, Mathematics, Drawing.
AVAN, E.	Passed in Religious Knowledge, English, Geography, French, Mathematics, English History.
MARSA, K. D.	Passed in Religious Knowledge, English, English History, Geography, French, Drawing.
THOMAS, H. V.	Passed in Religious Knowledge, English, Geography, French, Mathematics.
JONES, E.	Passed in Religious Knowledge, English, English History, Geography, French, Mathematics, Drawing.
BOYS.	
First.	
THOMAS, H. J.	Passed in Religious Knowledge, English, English History, Geography, French, Mathematics, Drawing, English Composition, English Literature, English History, English Grammar, English Spelling, English Reading, English Writing, English Arithmetic, English Science, English Moral Training.
THOMAS, T. W. N.	Passed in Religious Knowledge, English, English History, Geography, French, Mathematics, Drawing, English Composition, English Literature, English History, English Grammar, English Spelling, English Reading, English Writing, English Arithmetic, English Science, English Moral Training.

Top: Bhabha passed the Cambridge Local Examination (Juniors) in 1924 with Honours. The same year he was awarded the Headmasters's Prize for English Essay and the Hudson Prize for Mathematics.

Right: A Classroom at the Cathedral Boy's School, c. 1920s.



Years later, in 1955, C.H. Hammond, the retired Headmaster of his school wrote to Bhabha congratulating him for 'the eminent position you have reached in the world' and said that he took 'pride in having had a part however infinitesimal, in your education.' Bhabha responded warmly, acknowledging the significant role played by his alma mater.



A portrait of Homi Bhabha sent by him to his aunt Coomi from Cambridge in 1928.



The Early Years

for Einstein's theory of special relativity had invalidated many of the assumptions of classical physics and demonstrated that Newton's laws are true only for small velocities and do not work at the speed of light. After Einstein, the speed of light in a vacuum would become the limit for all material bodies; space and time would be seen as inseparable, and space, time and mass would be established as always being relative to the observer.

For a young boy exposed to classical physics, these were novel and difficult concepts to grasp. Perhaps, Homi was able to comprehend the complexities of Einstein's theory only because he had the ability to think in abstract terms. Observation of the natural world through ordinary sense perceptions would never enable one to understand the mathematical description of reality. As Homi would say many years later, science expands the mental horizon 'by demonstrating the limitations of commonsense ideas based upon the world immediately perceived by our senses'. 'Because,' as he would explain in the same speech, 'our senses perceive only a very small fraction of the phenomena of nature around us.'

But no matter how advanced his understanding of physics was he was only sixteen when he passed his school leaving examination, far too young to join any university abroad. He joined Elphinstone College and later the Royal Institute of Science in Bombay, in 1926.

The most significant event that marked his brief time at the Royal Institute of Science was a public lecture by Arthur Holly Compton. The American physicist, Arthur Compton, had begun studying X-ray scattering in 1918. By 1922, he had discovered that the wavelength of X-rays increases because of the scattering of radiant energy by 'free electrons' and the scattered quanta have less energy than the quanta of the original ray. Dubbed the Compton Effect or Compton scattering, this discovery had confirmed the hypothesis that high frequency radiation behaves as a stream of particles with quantized energies rather than waves. In 1926, Arthur Compton had come to make some measurements on cosmic radiation in the Himalayas. The next year he won the Nobel Prize in physics.

Compton's lecture made a deep impression on the young Homi Bhabha. It was at this lecture, as he would say later, that he first heard of cosmic rays. Who could have seen a connection between Compton's 1926 lecture and Bhabha's future research? At that point, it could not have been obvious to anyone. The following year Homi Bhabha would set sail for Cambridge where, eventually, he would be drawn into the kingdom of atomic physics over which Lord Rutherford reigned.

'The fine location of the Royal Institute of Science, its handsome building and the enthusiasm of some of the members of the staff made it a real pleasure to work there. The one year I spent studying there before I left for Cambridge was a very happy one. I remember that it was in the main lecture hall that I first heard of cosmic rays, the subject which was later to become my own special field of study. The lecture was a popular one delivered by the distinguished American physicist, Professor A.H. Compton, who had then come to India to make some measurements on cosmic radiation in the Himalayas.'

Homi Bhabha, Note on Royal Institute, 12 September 1945.

Bhabha joined the Royal Institute in 1926. The following year, just before he left for Cambridge, he painted a self portrait at seventeen. The intensity of the look portrayed here is at once sharp, expectant and inward – like a writer engaged in a soliloquy even as he turns himself into a work of art.



Cavendish Laboratory,
Cambridge.

3. CAMBRIDGE AND THE ROMANCE WITH PHYSICS



'If I could, I would spend my life in an observatory watching the tranquil motion of the stars, the harmony of numbers, everything happening as it has happened from times unknown; no star or mathematical symbol has a desire to go out of its place, to undergo any but its own destined function.'

Homi Bhabha to Homi Seervai, letter from Cambridge, 2 November 1927.

Homi's father had nurtured the hope that he would complete his engineering degree at Cambridge and join the industrial house of the Tatas. Not an unusual expectation given that in British India, a degree in engineering was seen as far more promising than a career in the pure sciences. Real research, it was widely believed, could never be carried out in the colonies. So when Homi arrived at Cambridge in 1927, he enrolled for a BA degree in mechanical engineering.

Although he had a particular talent for mechanical drawings and understood his subject, engineering did not capture his imagination. Sometimes, he disliked it with a passion. Besides, to young students Cambridge offered many distractions. He also had the opportunity to indulge and refine his love for western classical music. At Cambridge, he fine-tuned his ear for music. He listened to gramophone records and bought sheet music to follow the music better, thus teaching himself composition and structure. He even attempted a few musical compositions.

The days were busy. There were 'supervisions' to attend. The 'supers' as they are called in Cambridge slang were a unique system of teaching

1927 | FERMI DISCOVERS PENICILLIN | GAMOW EXPLAINS THE LIFETIMES OF ALPHA RADIATION | JOHN VON NEUMANN CONCEIVES GAME THEORY

1930 | DIRAC: THE PRINCIPLES OF QUANTUM MECHANICS | GANDHI UNDERTAKES THE DANDI MARCH



Ghahla on his Degree Day, second from the left.
F.J. Medler, fifth from the left.



in very small groups of two to four students. In the evenings, like other students, the young Homi must have gone walking along the river Cam. Sometimes, as his friend at Cambridge, the physicist Wilfred Bennett Lewis recollected, Homi would go sprinting at the University Cricket Ground, popularly known as Fenner's.

Soon after he arrived, Homi, lightweight and nimble, took to coxing at the boat races. He also naturally possessed the unique qualities that characterized coxswains, who sat at the stern facing the rowers, guiding them to steer the straightest and safest course. Besides, the cox had to know how to lead his team: to motivate them, to exhort them into forgetting their exhaustion, to exert their last bit of strength to a winning finish. More than three decades later, Homi would be remembered and appreciated by Gonville and Caius College as 'the cox of the fifth boat'.

In Cambridge Homi's artistic skills improved dramatically. He sketched the organ players, designed the cover of the *Caian* – his college magazine. He put his considerable draughtsmanship and artistic skills to work, designing the sets for a student performance of the seventeenth century Spanish dramatist Pedro Calderón de la Barca's play *Life is a Dream* and later, the sets of Mozart's *Idomeneo* for the Cambridge Musical Society. He showed his sketches to Roger Fry who praised his extraordinary talents and encouraged him to create works on a large scale. Indeed, for a while, Homi seriously considered becoming an artist.

If there were no tutorials or exams, the evenings were taken up with parties. It was a full life. A bit too full perhaps to accommodate serious preparation for examinations; when the results were announced, Homi



Top: Stage set for Mozart's Opera *Idomeneo* designed by Homi Bhabha. The opera was performed by the Cambridge Musical Society. It opened on 2 May 1939 at the Arts Theatre and ran for a week.



Right: The cover of the college magazine of Gonville and Caius College, the *Gaian*, Vol. 38-39, 1929, drawn by Homi Bhabha



Bhabha had got what was jocularly referred to as 'a Gentleman's degree', in common parlance, a Third Class.

His father was naturally disappointed by Homi's poor performance. As his brother recollected, 'My father was extremely upset that this should have happened. Then he told Homi that unless, you get a first class in your second part, I am going to recall you to India.' Homi responded, 'You will get your first class from me on the condition that you will finance me for two more years to do the Mathematics Tripos.' Homi's response to his father illustrates his special gift for negotiating what he really wanted even in adverse conditions.



Homi's interest in the Mathematics Tripos would not have come as a surprise to his father. Soon after his arrival at Cambridge, he had written to his father about the kindling of his interest in physics. Some months later, he had exhorted his friend, Homi Seervai to plead with his father on his behalf – 'Leave no stone unturned', he had urged. Physics was what

he wished to pursue and as he wrote to Seervai 'the mere circumstances that there is an opening in steel or hydro will not change my course'.

Cambridge and
the Romance with
Physics

Homi cleared the Mechanical Tripos in 1930 and the Mathematics Tripos two years later. Both with firsts. He went on to do a PhD with R.H. Fowler. His years at Cambridge coincided with what have been called the 'golden years' of the Cavendish Laboratory. It was here that he met and interacted with Dirac. In 1927 Dirac had proposed his quantum theory of emission and absorption of radiation. Soon afterwards he had formulated the Dirac equation which postulated the existence of negative energy states for electrons. Dirac had proposed that the negative energy states are each filled with an electron in the normal vacuum. According to the Pauli principle, negative energy states are consequently inaccessible to electrons in the vacuum. However, it is possible to excite an electron from a negative energy into a positive energy state – the unoccupied negative energy state then becomes accessible to electrons; in fact it behaves as a charged particle with an electric charge opposite to that of an electron, and one which the electron can annihilate to release energy.

1321

Excited by these developments at Cambridge, Bhabha had chosen to work on cosmic rays because they held out the possibility of testing out Dirac's quantum electrodynamics. In 1932 Bhabha travelled to Copenhagen, Zurich and Utrecht on a Rouse Ball Travelling Studentship. His first scientific paper, written in 1933 from Zurich when he was visiting Wolfgang Pauli, focussed on the absorption of cosmic rays and considered the role of electron showers – something he would elaborately and elegantly theorize about later. The following year Bhabha returned

Shakespeare Orders Lunch

*A composition by
Homi Bhabha,
16 October 1935*

*Dramatis personae:
Shakespeare
A serving man*

Shakespeare	What ho, without!
Serving Man	My Lord.
Shakespeare	Full twice or thrice Have I, with lusty and barbated speech, Sought to affront the portals of thine ears
Serving Man	Pardon, sweet lord.
Shakespeare	'Tis granted. Look you now, The time approaches when my corporal frame For lack of food grows incorroborate; Fetch me my spec, that I may make perusal Of whatsoe'er of viandry is set For our engorgement. (Reads) 'Item, pomfrets, one, Larded in his own licour and suffused With tinctures of Arabian agrimony' 'Tis well. What follows? "Tongues of Merlins, stewed, In choicest Malmsey, whereunto is added Savours of cinnamon and garlic." 'Sblood! It likes me not! Most vile concoction, Boding intestine boils! What follows next? "A goodly capon roast, and round it set Fat sausages of Oxenford." Methinks 'Twere wiser not too deeply to perpend The fount and source of those same sourceages - Ha, Ha! A regal jest! Yet ne'er a smile Illumes the face of yon unletter'd hind. The times are out of joint.
Serving Man	Pardon, sweet lord, The joint is fairly cooked.
Shakespeare	How palpable The scullion's wit! Peruse we once again: "The corned hump of a most reverend ox, That in the glades of Byculla Hath battened many a sennight unimpounded; And emerald sallet circles it around Wherein is interspersed the vermeil tinct Of ripe tomato, and the ensanguined blush Of ruddy beetroot." Ruddy is good, 'tis well 'Tis passing well. Go forth and sound a tucket, That all the world and eke his wife may know That I, Sir William Shakespeare, M.L.C., And likewise C.I.E. and O.B.E., Do take my lunch.
Serving Man	It shall, my lord, be done Ere minutes twain their fateful course have run.

[A tucket sounds without]

to Dirac's hole theory to explore positron interactions and this resulted in a paper which was published in the *Proceedings of the Royal Society*. As was his better known paper on the process by which fast charged particles create electron-positron pairs. This was later confirmed by experiments and is now routinely used to calibrate the beams at large accelerators using positrons and other anti-particle beams. Today this is known as the 'Bhabha scattering'.

Cambridge and
the Romance with
Physics

Two years later, Bhabha returned to the theory of electron showers, this time collaborating with Walter Heitler who was then at Bristol. The cascade theory of electronic showers put forth by Heitler and Bhabha demonstrated that when a very fast, highly energetic electron interacts with matter, there is a decrease in kinetic energy which appears as a high energy radiation photon which later produces a electron-positron pair – the electron produces another radiation photon and the positron when it annihilates some other electron gives rise to a pair of radiation photons. This process goes on till the energies fall below a threshold. This cascade effect produces a shower of electrons, positrons and photons as it spreads downward. Bhabha and Heitler's cascade theory of cosmic ray showers was viewed as providing a more accurate description of experimental observations with a cloud chamber than earlier theories.

1341

This creative phase culminated in a bold prediction. Taking up the 'hard' or penetrating components of cosmic rays which at that point still seemed an enigma, as quantum electrodynamics was unable to account for them, Bhabha conjectured in 1937 that the penetrating component of cosmic radiation comprised 'heavy electrons' the majority of which 'must have masses nearer to hundred times the electron mass'. He was not alone

in coming to this understanding – Neddermeyer, Anderson, Street and Stevenson had reached similar conclusions in their separate papers in the *Physical Review* the same year. These particles subsequently called muons were first observed by Neddermeyer and Anderson in 1938.

However, before the discovery of the pions in 1947, the muons were often confused with Yukawa's mesons. When Bhabha wrote his paper in 1937, he was unaware of Hideki Yukawa's theory of the meson which Yukawa had proposed in 1935 in the *Proceedings of Physical and Mathematical Society of Japan*. When the paper was drawn to his attention by his collaborator Heitler, Bhabha identified the meson as the particle he had predicted. In a 'Note' to *Nature* in 1939 Bhabha argued that this particle be named 'meson' and not as Carl Anderson had argued 'mesotron'. This argument about naming the meson would continue among cosmic ray physicists for a while.

Bhabha explored other dimensions of the meson as well – identifying it as a particle that tested the time dilation phenomenon predicted by Einstein in his Theory of Special Relativity. Using Proca's field equation to describe the meson field, he demonstrated that mesons were vector particles rather than scalar particles as Hideki Yukawa had originally proposed.

During his time at Cambridge Bhabha travelled to Europe and forged bonds of science and friendship with Niels Bohr, Wolfgang Pauli, Enrico Fermi and Hendrik Anthony Kramer among others. These friendships would survive the tragedy that overwhelmed science and humanity in the twentieth century.

Hormasji 'Homi' Maneckji Seervai (1906-1996) was a close friend of Homi Bhabha's. Like Bhabha Seervai was educated at Elphinstone College. Bhabha's letters to Seervai are remarkably frank, insightful and at times precocious. Homi Seervai went on to become a leading Indian jurist and the Advocate General of Maharashtra. Bhabha and Seervai shared a love for philosophy. They also discussed books, historical figures, logic and forms of government.

Cambridge and
the Romance with
Physics



Top Right: Homi Seervai, his mother, Meherbai and brother, Nalwan Seervai, c. 1920s.

Above: The envelope of a letter from Homi Bhabha to Homi Seervai, 1928.

Right: Homi Bhabha c. 1928

Excuse my
shod writing

Gonville & Cam
Colleges
Cambridge

2. 8. 1828.

02.08.28 HOMI TO HOMI

My dear Homi,

You have got a wrong impression from my letter. I am not cut up about the example myself. I know what has happened and as you say accidents will occur. I was only upset about my people. But they have got a letter from my tutor now, and are quite satisfied.

I am doing engineering now, but it is not very interesting. I feel the interest that an intelligent person ought to feel in everything. In fact, I was taken round the zoology labs by Setna of the R.I.S. who is doing research here, and I felt far more thrilled by that. However, I am determined to do physics and astrophysics eventually. Nothing will stop me.

The mere circumstances that there is an opening in steel or hydro will not change my course. If I got into one of these it will be only as a means of earning my bread. I shall devote every bit of my available time and interest to physics. Besides, I do not agree with modern commerce. I am strongly opposed to the ways and ideas of the world. I do not care two hoots for anybody. I am going to go my own way against the world if it is in my way. I am an idealist to the core, and character enough to put my idealism into practice as far as I am concerned. How can a person like me be ever expected to work harmoniously in a steel work, when at any instant I might explode against it.

You will say that this will develop much friction and heat, and perhaps temporary unhappiness. But I am prepared to go through all that. Has a man in this world done anything worth doing, that has been looked up to by posterity, ages after his death, without coming into violent conflict with the world, without bitter opposition on many sides. They have all been undeterred by the vulgar opinion and despised it. Among the philosophers, from Socrates to Schopenhauer and right up to Bertrand Russell, who in case you do not know it, was in prison for some time, and always in conflict with the present age. In music from Beethoven, Mozart to Wagner. In art from Leonardo to Rembrandt, and in science from Archimedes, Galileo to Einstein. As you know, I do not care for anything that is of practical use or that the world values.

If you see my father, I earnestly ask you to impress this view upon him and convince him that scientific research is my only line. Leave no stone unturned. By the way, could you find out and let me know what openings there are in India for the same.

In your letter you say that you hope you will have time to continue philosophy. From your own life circumstances must not lead you. I would only quote to you the story of Beethoven. One great dramatist, I forget who, sent a libretto to Beethoven with the inscription, "... completed by so and so with the grace of God." Beethoven in his heroic manner scratched out the last words and wrote 'Mon! Help thyself.'

I must close now. Hoping that you are in the best of health.

Yours v. sincerely

Homi J. Bhabha.

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02 01 29 HOMI TO HOMI

My dear Homi,

I received your letter on New Years' Day. I thank you for the good wishes. I have been very pressed for time lately and I have not written to you for sometime partly because of my bad habit of leaving off writing letters to the last day. Though late, I wish you a very Happy New Year, full of success and sincerely hope that all your ambitions for 1929 and more will be realized by the end of this year.

This letter is also written in a slight hurry, and so you will excuse any mistakes (this applies to all my letters) and the lack of any great order in the thoughts jotted down. I do not think it worth writing to you unless I can write an intelligent letter, because I don't think I can be of great interest to you that I had Christmas cake on Christmas unless it causes some reflections. Anybody can eat Christmas cake. After all, we are what we think.

Cambridge and
the Romance with
Physics

I do not read the papers still, but I have begun to take a slight interest in general politics in India. I agree with you in considering Democracy the only form of government which will give at least a tolerable rule, though it is very far from being an ideal. The Platonic ideal may be ruled out in the present day. You support it because it is 'the only possible one which is consistent with the freedom of man'. 'Liberty', writes Napoleon in a private letter 'liberty is only the need of the few whom nature has endowed with exceptional talents, and there is no danger in restricting it. The crowd loves equality'. I agree with him here. A rule by a very efficient man like him or an efficient aristocracy is very good from the point of view of culture at least, and most other points of view, but there is always the trouble of who is to succeed afterwards, and what would happen in case the man or aristocracy should degenerate. Thus I vote for democracy. We have very little real liberty. The greater the city in which one lives, the more restricted does one's liberties become. At Cambridge I so arrange most of my meals, that I do the maximum possible amount of work, and the time of the meals vary from day to day, sometimes by 2 hours, because I have most of them alone. This is impossible when one is with friends or a family. Moreover, the love of the crowd for equality is only a form of envy. Napoleon gets over this by giving distinctions to those who are most intelligent and efficient because this envy becomes intensified if it is for people who do not deserve their lot, as in the French Revolution. I agree, that for a really good and efficient Democracy there ought to be a widely diffused culture throughout the masses. You will be surprised how uncultured the average Englishman is. He has only acquired a certain sense of responsibility, and a certain sense and forbearance in political matters through long experience in this form of government, which makes the government more or less stable. This sense can only be formed by experience, and therefore, it is unreasonable to expect a democracy in India which shall not make some blunders in the beginning, some even of a serious nature. We must remember France in the revolution. A man, to have any self respect, must have a certain background of culture, a certain pride in his race, which can only be cultivated by showing to him the greatness of his own race at various times in history, the high culture that they possessed, or how they advanced universal knowledge. India is not lacking in such past culture. It has one of the greatest in the world. What is required is to revive this ancient culture, to modernize it, to take and blend with it the greatest and best parts of European culture, for if a nation is to live, and lead the world, it must possess a culture which is alive, which continues to change and evolve. Our aim should be to produce a type which is capable of appreciating Eastern art as much as Western, though he may have a preference for one, not a type to whom anything Eastern or anything Western is incomprehensible. For that is the future of man. Unity of all mankind cannot be achieved by blotting out one civilization and implanting another. As a preliminary step, a

new and unbiased history of India ought to be written which ought to be taught in schools. The past that ought to be more studied is not the Mogul period, but some of the more ancient periods, such as those of Chandragupta and later – I mean the real Hindu empires. The causes of their fall ought to be stressed and the grosser blunders of the princes in the day of the East India Company, which eventually led to the conquest of India by England, ought to be plainly brought forward. I feel very strongly that for any unified nation to appear, the princes must be wiped out. If there are any very intelligent princes, well they could join the assembly or the governing body of the Indian nation as representatives. The stupid ones deserve to be deposed and forgotten. But England herself will not depose the princes, for they act as a strong bulwark against a unified India, and their support in any National movement to drive out England must be calculated for the English. If any should come on the Indian side, well, it will be an additional help.

At present they are very much like the German princes of Napoleon's time. Since England wants to keep India, it will not of its own accord introduce an unbiased history, and will tend to suppress any dangerous type of culture, with the result that it will have to be done by Indians, and a great nation will only rise after they have been driven out. When all nations are free, when all parts are self governing, then only can one hope for world peace. Then a strange process will have to be undergone. Great nations will have to be welded together and yet each nation will have to be broken up into a number of internally self governing districts. Armies will eventually cease to exist, and a highly efficient police force will keep internal order. For when a very very large land and political unit, (in the end the whole world) is made up of a number of small divisions, all more or less equally powerful, then it would be impossible for any of them to try and fight, for it would be overpowered by the rest. Thus in a way it will be a return to the city state. You will have noticed that city states, whether in Ancient Greece or Renaissance Italy, have produced the highest types of culture, and the greatest art on the whole. I visited the British Museum the other day. I went through the Egyptian, Babylonian, and Assyrian rooms, though rather superficially, for I am going again. I was impressed by the massiveness of some of their monuments and eventually disgusted. It was only when I came to the Greek section that I thought I had arrived into any real state of culture. Then my mind was overwhelmed with the beauty of the statues. I shall go there again for I only glanced at them. But the climax came when in a small corner of a large room were busts and heads, on marble pillars of Greek philosophers.



Demosthenes with profound insight, dreamy gaze, cunning nose, and lower lip a little behind the upper one; Homer with calm mouth and rugged brow, the whole of the upper face and parts around the eyes distorted with inspiration; Epicurus with a calm look; the man who calumniated the Stoic school, with his eyes turned to heaven; Pericles with a kind expression, the great leader of the Greeks; and lastly, the greatest of them all, with features like the god Silenus, one of the greatest philosophers of all time, Socrates. I would write more, but I must stop.

I seriously ask you to read Napoleon by Emil Ludwig. It is a great work of literature as an autobiography and will be highly instructing to you in political history. He was a great man. It will inspire you to work and labour hard. Give twofold strength and energy to you. With love,

Yours v. sincerely,

Homi J. Bhabha

3 Belton Road,
Rugby.
11. Sept. 29.

My dear Homi,

I am now in Rugby for two months, where I am getting practical experience. I go as a workman to B.T.H. works. Hitherto, the experience has confined itself to the filing, drilling etc of bits of iron and copper and in fact making odd bits or parts for different machines. The labour is quite unintelligent and soon becomes boring. I am quite wasted on a job that any unintelligent man could perform, possibly better because he would attach more importance to it. It does not follow, that you will get a small hammering job performed better if you use a stone sledge hammer instead of a small hand-hammer. I have been here about five weeks and will be about 2 more. I spend all my spare time reading books on philosophy, music, painting, physics and engineering. But the trouble about going to these works is that one has not much time left for anything else. I start at 7.30 and work till 5, with an hour off for lunch 12-1. When one goes in the morning, one has to pass through some gates where one gets a round disc with one's number on it. The gates close punctually at 7.30 as a whistle blows and every one has to be in by then - you don't get your ticket. Then you have to go to the department where you work and put the disc into a machine within 2 minutes past 7.30. If you are later than that you lose half an hour. The same is repeated at lunch time. If you happen to miss passing through the gates, they will sometimes note your name and put you down as half an hour late. You put the rest of the time. One can always go into the works at any time, but it is no use going unless you have your ticket in, because you get paid nothing for it. I strongly object to this mechanization of man. I despise all businessmen, industrialists and engineers as such. What they do with great self importance is nothing great. Any man of average intelligence could do it. With these views and my temperament, how can you expect me to be an engineer? I think it very unlikely that I shall be one. My father has been very reasonable and good, and has promised me one more year at Cambridge after I have finished my engineering Tripos for the pursuit of physics, perhaps two. Then if I do well, I may do research at Cambridge and stick to Physics.

I don't know if I told you this before but Dr Meldrum called my father and grandfather especially before I left India, and told them to make me a scientist or a professor as he thought from my general work and questions during the time I was under him, that I was built for a scientist, and had an original mind.

To return to the industrialization, this destructive and dangerous mania for machinery has been condemned by Epstein in a piece of sculpture, a great work of creative imagination which has not been appreciated as it ought to be. I quote from a book on modern art which I have just read, and which you would find interesting. It is not technical. I bought this book out of the prize I got in the Bombay Art Exhibition. It is called 'Evolution in Modern Art' by Frank Rutter.

'This strange monster, this inhuman creation with its aspect of relentless power and determination of monkeylike inquisitiveness and ingenuity, of machinelike precision and callousness, a symbol of the brute force that stifles human thoughts, contracts human liberty, and maybe human bodies. It is this terrible Moloch, and all it stands for, that Epstein has expressed plastically; only instead of labelling it as a denunciation of Prussian militarism he has chosen to hurl his invective in bronze against the blacker aspects of the basic form of industrialism. It is a reflection on the intelligence of the age, that this tremendous fact of creative imagination - executed in 1913 - is, at the moment of writing, still in the possession of the sculptor'.

Since I have been here, I have read Bertrand Russell's *Popular Exposition of Relativity*, which is very good, though quite intelligible, and am now reading his *Problems of Philosophy*, a book which is also meant for the thinker who is not a student of philosophy. Some of the subjects discussed are very delicate and difficult and there are some points about which I am not quite clear and fully satisfied. I don't know if you know the book. This I suppose would be quite simple to you. For instance, one of the points about which I am not satisfied is Kant's view that $5+7=12$ is a synthetic and not analytical statement. 5 and 7 and 12 are merely symbols for ideas. Five for instance is not an idea of the nature of, say, Infiniteness. Five, I think, symbolizes the result of a process, the result of counting a certain number of objects. By the very nature of 6, $5+1=6$, since 6 is the result of the process of attaching names to a sequence of objects (counting) with one object more than there was when we counted 5. Thus, to take the simpler proposition, $2+2=4$; this reduces to $2+2=3+1$. But $2+2=2+(1+1)=(2+1)+1=3+1$. The brackets are put in to exemplify what I mean.

The only objective seems to me to be whether the brackets can be so shifted. But the brackets are only there to make clear my meaning, I don't think they invalidate the argument. In that case, the statement $5+7=12$ when expanded with the meanings above attached to the symbols, seems to become analytical. I admit it is not analytical in the same obvious way as 'A bald man is bald'. Modern physics has shown the danger of attaching from metaphysical notions to space as it exists without reference to the method of measuring them and so, I don't know what one can mean by five except the result of attaching a fixed sequence of words to objects in succession, in fact, counting. This may appear childish confusion to a philosopher, but I hope you will take the pain to explain to me when I am wrong, or how numbers are defined. I don't see in what other way we are acquainted with five or any other number.

For the last week I have spent an hour a day studying counterpoint, which is a part of the technique of musical composition. Yesterday, for the first time in Rugby I went out sketching, drawing a railway bridge at dusk. I shall paint it tomorrow. I have been reading a technical book on oil painting by S.J. Solomon. One thing appears here, that he is a very good technician, but a man without an original mind, in fact not a great artist. All academicians are like this, or they would not be academicians.

I must stop now, as I have to write to my parents. I have been wondering how it would be possible to live in India and be an artist of the first rank. For, all the new ideas in art and science, penetrate to India, if at all, after some time, and one is bound to miss opportunities for suggestions which in one's own mind might develop into something. The atmosphere is lacking. This is of course, from the point of view of European culture. Lalkaka, like the Academicians here is merely a painter, not a creative artist. The creative artists are those who are so often stigmatized as cranky and appreciated only in small circles.

Hoping you and all at home are well,

With love,
Yours v. sincerely

Homi

Homi Bhabha had worked on his PhD under the guidance of Sir Ralph Howard Fowler (1889-1944) at Cambridge. Fowler, OBE, FRS, physicist and astronomer, was elected to the chair of theoretical physics at the Cavendish Laboratory in 1932. Several distinguished physicists such as Arthur Milne, Sir Arthur Eddington, S. Chandrasekhar and Paul Dirac, to name but a few, had worked with Fowler. Bhabha's thesis (title page shown below) 'On Cosmic Radiation and the creation and annihilation of Positrons and Electrons' was awarded the PhD in 1935.

ON COSMIC RADIATION AND THE CREATION
AND ANNIHILATION OF POSITRONS AND ELECTRONS

- by -

H.J. BHABHA.

Trinity College

Part I is a theoretical discussion of the important experiments on cosmic radiation and a short general survey of the subject. Only some of the theoretical considerations in Part I are original. Parts II and III are original. Numerous references are given in the text, which, it is hoped, will serve to show what parts of the thesis are not original.



Piotr Leonidovich Kapitza (1894-1984), FRS, won the Nobel Prize in physics in 1978 for work done in low temperature physics in the 1930s. As a young research student at the Cavendish, he founded the Kapitza Club on 17 October 1922. The Kapitza Club which met in Kapitza's room at Trinity and later, at Cockcroft's room in the Cavendish, promoted informal discussions about scientific developments, often adopting a Russian style of argumentation. Speakers at the Kapitza Club included Dirac, Blackett, Cockcroft and Heisenberg among others. The Kapitza Club register below shows that Maurice Pryce (whose letter to Bhabha we have included on p. 80) spoke there a few weeks before Bhabha. Bhabha spoke on 'The heavy electron' on 1 February 1938.

479th Meeting. Nov. 16th 1937.

Absorption of soft X-rays in metals. H. Jones.

480th Meeting Nov. 23rd 1937.

News from the bottom of the Atlantic. B.C. Brown.

481st Meeting Nov 30th 1937

Capture of orbital electrons in β -decay theory J. Hoyle.

Can neutrons be polarised by laser + mag. field *McDonald*

482nd Meeting Jan 11th 1938

Theoretical predictions about distribution of neutrons emitted from excited nuclei

M. H. L. Pryce

483rd Meeting Jan. 18th 1938

Discussion on He II.

J. F. Allen H. Jones.

484th Meeting Jan. 26th 1938

Low temperature heat conductivity in metals

McKusick

485th Meeting

Feb. 1st 1938. The heavy electron. H. J. Bhabha.

486th Meeting Feb. 22nd 1938

Nuclear theory + stellar evolution

R. E. A. Thomson.

PUBLICATIONS WHILE AT CAMBRIDGE : During his time at Cambridge, Bhabha worked on what is now called the 'Bhabha scattering' and with Heitler on the cascade theory of cosmic ray showers. He also conjectured about the Yukawa particle or the 'meson'.

Cambridge and
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The Passage of Fast Electrons and the Theory of Cosmic Showers

BY H. J. BHABHA, *Gonville and Caius College, Cambridge*
AND W. HEITLER, *Wills Physical Laboratory, University of Bristol*

(Communicated by N. F. Mott, F.R.S.—Received 11 December 1936)

INTRODUCTION

It is well known that according to relativistic quantum mechanics, electrons and positrons with energy large compared with their rest mass have a very large probability when passing through the field of a nucleus of losing a large fraction of their energy in one process by emitting radiation. Hard quanta have a correspondingly large probability of creating electron pairs. Until recently it was believed that the direct measurements of Anderson and Neddermeyer on the energy loss of fast electrons showed that though this energy loss by radiation existed, it was much smaller for energies greater than about 10^8 e-volts than that theoretically predicted, and it was therefore assumed that the present quantum mechanics began to fail for energies greater than about this value. More recent experiments by Anderson and Neddermeyer (1936) have, however, led them to revise their former conclusions, and their new and more accurate experiments show that up to energies of 300 million e-volts (the highest energies measured in their experiments) and probably higher, the experimentally measured energy loss of fast electrons is in agreement with that predicted theoretically. In fact, one may say that at the moment there are no *direct* measurements of energy loss by fast electrons which conclusively prove a breakdown of the theory. This is particularly satisfactory, inasmuch as the theoretical reasons for expecting a breakdown of the theoretical formulae at energies greater than about $137 mc^2$, namely the neglect of the classical "radius" of the electron, have been shown by v. Weizsäcker (1934) and Williams (1934) to be unfounded. Under these circumstances, and in view of the experimental evidence mentioned above, it is reasonable *as a working hypothesis* to assume the theoretical formulae for energy loss and pair creation to be valid for all energies, however high, and to work out the consequences which result from them.

It is our aim to deduce results which can be compared directly with cosmic ray experiments and which will then allow one to decide whether

Jamshed Jehangir Bhabha was also in Cambridge during the time his brother was there.

IC: It must have been nice to have your brother also at Cambridge. Did you interact with him a lot?

JJB: Very much. I was very fond of him. Homi's love of poetry was derived from me – because I knew Shelley and Keats and I used to give him books to read. And music of course was a common thing. Homi was the conductor of the Cambridge University Orchestra. He designed beautiful stage décor and when it came to the exam, he got a Third Class. My father was extremely upset that this should have happened. He told Homi, 'This is not going to do at all. Unless, you get a first class in your second part, I am going to recall you to India'. Now, Homi at that time said, 'If that is what you want as a condition, then I want to strike a bargain with you. You will get your first class from me on the condition that you will finance me for two more years to do the Mathematics Tripos'.

Sir Maurice Vincent Wilkes (b.1913), FRS, British computer scientist, built and designed the EDSAC, the first computer with an internally stored memory in 1949. Sir Maurice first met Homi Bhabha in Cambridge. Many years later, he visited Bhabha's Institute in India.

I was born on 26 June 1913 and was therefore some four years and eight months younger than Homi Bhabha.

When I became a registered research student in the Cavendish Laboratory in October 1934, Bhabha had just submitted his thesis and was awaiting a decision by his examiners. He duly received the degree and stayed on in Cambridge as what we would now call a post-doc.

An event of which I retain vivid memories is the Cavendish dinner held just before Christmas 1938. Such a dinner was organized annually by the students, and there was a tradition that after a few formal speeches, the atmosphere should become relaxed and light hearted. The previous year, Lord Austin, a prominent manufacturer of popular cars, had announced a major benefaction to the Laboratory to enable additional accommodation to be built and work was in progress on the Austin Wing, as it was called. Lord Austin was the guest of honour at the dinner. This occasion provided the young Bhabha with unrivalled opportunities for his high spirits. His most striking contribution was a full-sized portrait of Lord Austin which he had painted himself and which he ceremoniously presented to Lord Austin at the dinner. I was told that it was painted on brown paper.

There was another frolic that had every sign of being the fruit of Bhabha's imagination, although it may have owed something to others as well. It turned on the fact that the word wing has two meanings in English; it is both an architectural term and is also used to

describe a part of a car, in particular a part of an Austin car. As Lord Austin had presented the building known as the Austin wing to the Laboratory, it was argued that the Laboratory owed him the other sort of wing in return. Accordingly, a wing from an old Austin Seven car, duly cleaned up and painted, was 'presented' to Lord Austin at the dinner. What he thought of this boyish jest I do not know. Another reason I have for remembering the dinner is that J. J. Thompson was also present. He was then 82 years old.

In 1964 when Harry Huskey, of the University of California at Santa Cruz, was invited by a consortium of American Universities to organize a course of lectures on computer topics at IIT Kanpur, he invited me to be one of the lecturers. I accepted and resolved to visit the Tata Institute on my way. Vikram Sarabhai, with whom I had been in touch on a problem connected with cosmic rays, helped me with the arrangements.

Bhabha, as head of the Tata Institute, greeted me warmly as an old friend. He not only arranged for me to see the Institute, but he also arranged for me to have an extensive tour of the Atomic Energy Establishment at Trombay of which he was also Head. This included a visit to the plutonium separation plant, then in process of erection,

Bhabha was generous with the amount of time that he gave me. I thanked him for this, saying that I knew that he

must be very busy. He said that apart from scientists, he could not normally make time to see people from ordinary countries unless they were Heads of State, although he would stretch a point for Prime Ministers of the more important countries. I said that I hoped that he included the United Kingdom among the latter. He replied, with one of his engaging smiles, that he certainly did, adding that it would be a poor day if this were ever no longer the case. I make no comment on this exchange of banter.

I shared Bhabha's enthusiasm for the visual arts, although I could not bring to them the personal artistic ability that he did. When I remarked on the number of works of art on view in the Institute, he explained that the government of India was one of those enlightened governments that allowed a small percentage of the total funds spent on new government buildings to be spent on artistic enrichment. Bhabha said that, unlike many of his colleagues, he took advantage of this provision 'up to the hilt'.

Bhabha was a member of the Cambridge Philosophical Society which awarded him the Hopkins Prize in 1948



CAMBRIDGE PHILOSOPHICAL SOCIETY,
NEW MUSEUMS,
FREE SCHOOL LANE,
CAMBRIDGE.

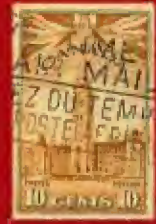
'It is now almost one o'clock and I cannot help writing to you. I came back from the concert at about eleven or earlier and have been thinking of the Ninth Symphony all the time. I am so overwhelmed by it that I can neither talk nor think of anything else. Never before have I been so moved. The performance was by no means faultless and Henry Wood is not the best conductor for Beethoven. But all the faults of the execution are forgotten in the greatness of the work. I was drawn out of myself and raised to sublime heights and my mind hardly got back to work till a long time after the end. I walked back in a dream, and now that I think of it, I am surprised that I got back at all. It is the sublimest and happiest time I have ever had in my life'.



Lettice Ramsey (1898-1985), a Cambridge photographer, was the widow of the mathematician and philosopher, Frank Plumpton Ramsey. Lettice is best known for her portraits of scientists and intellectuals. She shared a studio with Helen Muspratt which was the venue for social gatherings of the young intellectuals of Cambridge. Bhabha not only had himself photographed by Ramsey, he also acquired her portraits of Lord Rutherford, J.J. Thomson and Paul Dirac for his Institute in 1950.

Top: Homi Bhabha standing in front of his own painting.

Left: Homi Bhabha at work on his painting inspired by the Countess' Aria "Dove sono i belli momenti" from Mozart's opera *The Marriage of Figaro*.
[Photographs by Lettice Ramsey]



4. THE PLEASURES OF EXILE

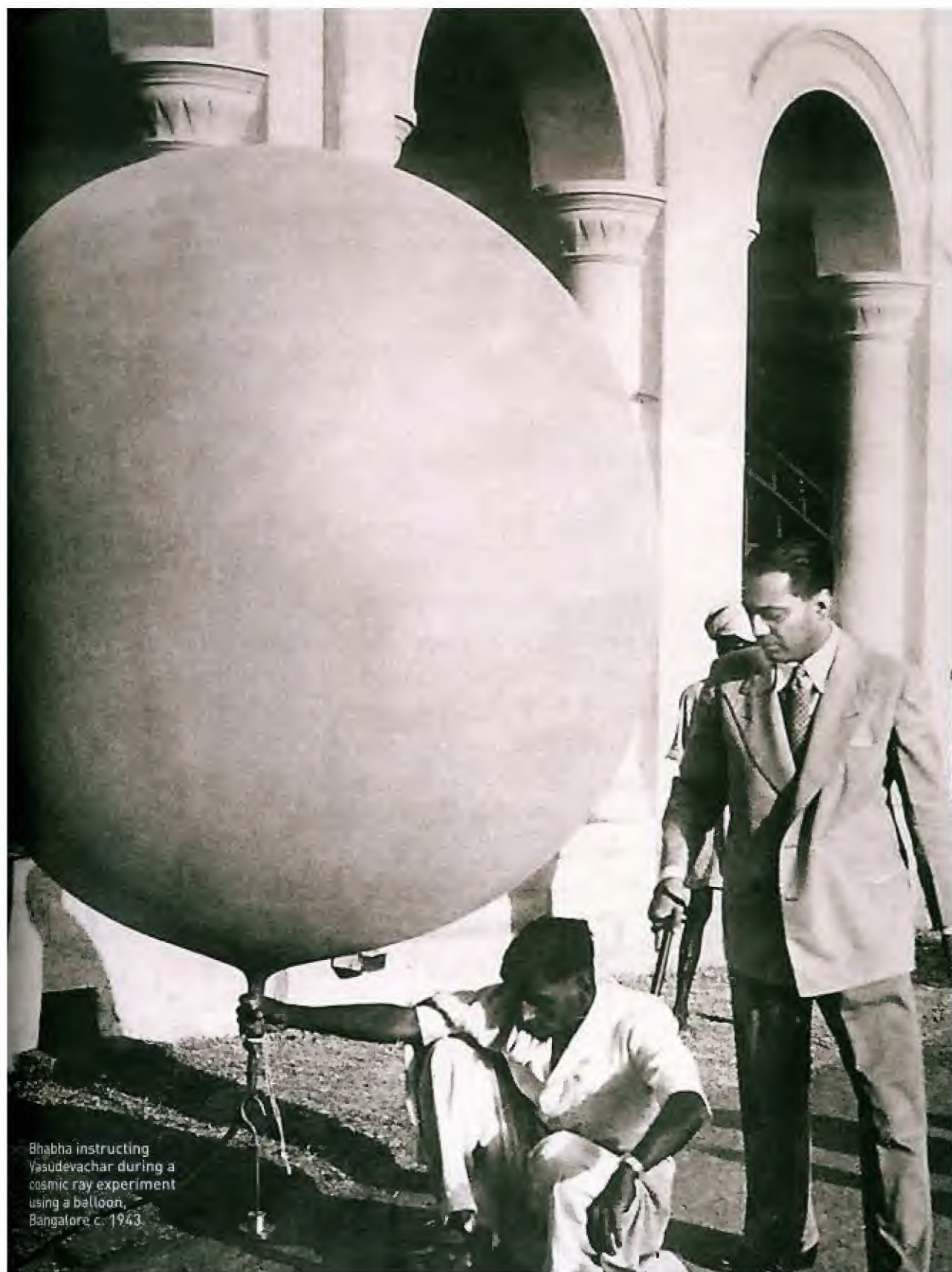
'And my memories go back not only to the brilliant lectures in Physics which inspired me when I was a young graduate student, but to the many visits we paid to temples in South India, to Basavangudi where classical recitals of Indian music were given and to the many lovely excursions which we took together. Those of us who had a personal contact with Dr Bhabha know that science was an important part of his life but that he was a Complete Man in the best sense of the term as we understand today'.

Vikram Sarabhai, speech at the condolence meeting for Dr H.J. Bhabha at AEET, Trombay, 25 January 1966.

Although ominous clouds of war were fast gathering over Europe, Homi had expected to return after a short holiday at home. But that was not to be. When the war broke out in 1939, he found himself exiled from the Cavendish. He joined the Indian Institute of Science in Bangalore and went about building his own laboratory. He also embarked on his own journey of discovery – visiting the temples of Belur and Halebid, marvelling at the architecture. In Bangalore he attended in the company of Vikram Sarabhai, Sunday morning concerts of classical music at Basavangudi. Evenings were often spent at the Westend – a hotel he would stay in whenever he visited Bangalore in later years.

The circumstances at IISc were unusually conflict-ridden at that time: the Council at IISc was hard-pressed to resolve its differences with Sir C.V. Raman, the first Indian director; as well, there was major tension between the department of physics and the department of chemistry. But Raman extended his support and friendship to Bhabha and elected him a Fellow of the Indian Academy of Sciences. He also nominated Bhabha to the Royal Society of London in 1941.

Bhabha's Cosmic Ray Unit at the Indian Institute of Science was set up in one of the verandas adjoining the library with a fund from the Sir Dorabji Tata Trust. It was here that he started work with a small group



Bhabha instructing
Yasudevachar during a
cosmic ray experiment
using a balloon,
Bangalore c. 1943

of scientists and dedicated students, among them the mathematician Harish-Chandra. But he yearned for the war to be over, as he wrote to Millikan in 1941, so that 'we can all turn again in more favourable conditions to purely scientific activity'. He had hoped to spend time in Caltech but there was no way Millikan could invite him there. The war and the restrictions on finances also made it impossible for Wolfgang Pauli to invite him to Princeton.

The Pleasures
of Exile

Despite the disappointment, Bhabha found a local collaborator in the mathematician B.S. Madhava Rao who had worked with Max Born during Born's brief time at IISc. With Madhava Rao he published a paper on 'the scattering of charged mesons'. Soon he had other collaborators and students in S.V. Chandrasekhar Aiyar, R.C. Saxena, M.S. Sinha, D. Basu and S.C. Chakraborty. With Chakraborty, Bhabha further explored Cascade theory, improving the theoretical treatment that he had earlier done with Heitler in order to bring it closer to the observational data that had become available. His notebook from this period shows that he was taking careful notes from the theoretical works of Snyder and Serber. Finally, Bhabha and Chakraborty's solution was seen as an analytical continuation of Snyder and Serber.

1541

Around the same period, Bhabha also used the theory of orthogonal groups to explain the interactions of elementary particles. Encouraged by Dirac, he submitted his essay 'The Theory of Elementary Physical Particles and Their Interactions' for the Adams Prize even as the war raged on. He won the Adams Prize in 1942.

The swarm of experimental data that had enabled his phenomenological

work at Cambridge was no longer available, so in Bangalore Bhabha's work became more mathematical. In 1943 he turned to experiments himself. The latitude effect on mesons was one of the first problems he sought to explore. This work was in part inspired by Millikan who had visited India just before the war and again in 1940 to compute the different amounts of cosmic ray energy at different latitudes. But there was a war on and the rubber balloons Millikan had used were unaffordable. Ever ready to think up new solutions, Bhabha approached the US Air Force and had GM telescopes flown at 30000 feet. On 26 and 28 December 1944 two flights were conducted and lead pieces exposed for half an hour at altitudes ranging from 5000 to 30000 feet. The team thus measured for the first time the high altitude intensity of penetrating particles at the equatorial latitude.

Throughout his time at IISc Bhabha kept up his correspondence with the international community of scientists he had known during his time at Cambridge. Conditions were far from ideal. Although he had been elected Fellow of the Royal Society in 1941, he had not yet undergone the admission ceremony at the Royal Institute. Sir A.V. Hill who visited India during the war (carrying with him a special parchment leaf from the Institute) conducted the admission ceremony in Delhi just before the Indian Science Congress commenced in 1944. This was the first time that such a ceremony was held outside of the Royal Institute.

The recognitions that came his way enabled him to think about what was possible for science in India. Besides, the dream of an independent India was slowly but surely beginning to appear on the horizon. It was time to build for science in India.

R.P. Shutt. '42, P.P. 61, 8-13.

On the Electrical & Anomalous Scattering of Mesons

Scattering measured in 1 cm & 5
Pb plates in chamber. Most of the
scattering multiple Coulomb scattering,
is proportional to \sqrt{t} . (t = thickness)
An excess scattering in 1 cm Pb, not
increasing as \sqrt{t} amounts to $\sim 2.3\%$
of the no: of particles, and leads to
a cross-section per nucleon of neutrons

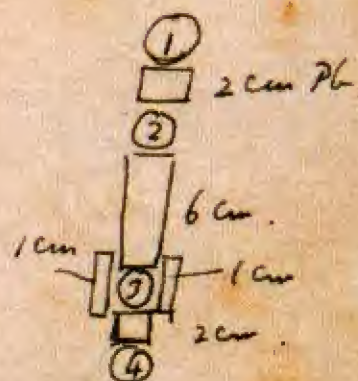
$$\sim 6 \times 10^{-28} \text{ cm}^2.$$

This agrees with Code's result to order of
magnitude; & Wilson's.

Intensity & rate of productions of mesotrons in the
stratosphere

(B)
Coincidences 123 / and 234 (A)
separately recorded.

Flight upto 3.6 cm Hg, where B
intensity reached 8 times value



at S.L. Max intensity at
(17.6 km) being 11 times S.L. // A-B
6.6 cm Hg

was production of penetrating particles by
ionizing rays in top 2 cm Pb. This curve
became appreciable at 6 km. & attains 25%
of total penetrating intensity at 17.6 km.

Log of H against pressure gave
straight line from 8 cm Hg to 5.0 cm Hg
with absorption coeff. $\mu = 1.2 \times 10^{-3} \text{ gm}^{-1} \text{ cm}^{-1}$
for higher pressures μ falls to $.7 \times 10^{-3} \dots$

The total vertical intensity

PUBLICATIONS WHILE AT BANGALORE: At IISc Bangalore, Bhabha continued his theoretical work but also turned to experiments. He worked on relativistic wave equations and on the theory of point particles with his student, Harish-Chandra, who went on to become a renowned mathematician. He worked on collision loss and the Cascade theory with his student S.K. Chakraborty who later became the Director of the Indian Institute of Geomagnetism, Bombay.

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Bhabha H.J., Carmichael H., Chou C.N. 1939. "Production of bursts and the spin of the meson". *Proc. Indian Acad. Sci.* 10A: pp 221-223.

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Bhabha H.J. 1939. "Classical theory of electrons". *Proc. Indian Acad. Sci.* 10A: pp 324-332.

Bhabha H.J. 1940. "Classical theory of point dipoles". [letter]. *Nature*, London, 145, pp 819-820.

Bhabha H.J. 1940. "Classical theory of spinning particles". *Proc. Indian Acad. Sci.* 11A: pp 247-267 and Errata on pp 467.

Bhabha H.J. 1940. "On elementary heavy particles with any integral charge". *Proc. Indian Acad. Sci.* 11A: pp 347-368 and Errata on pp 468.

Bhabha H.J. 1941. "Protons of double charge and the scattering of mesons". [letter]. *Phys. Rev.* 59: pp 100-101.

Bhabha H.J. and Rao B.S.M. 1941. "The scattering of charged mesons". *Proc. Indian Acad. Sci.* 13A: pp 9-24.

Bhabha H.J. 1941. "Note on the correspondence between the classical and quantum theories of neutral mesons". *Proc. Indian Acad. Sci.* 13A: pp 249-254.

Bhabha H.J. and Corben H.C. 1941. "General classical theory of spinning particles in a Maxwell field". *Proc. Royal Soc.* 178A: pp 273-314. [Communicated by P.A.M. Dirac]

Bhabha H.J. 1941. "General classical theory of spinning particles in a meson field". *Proc. Royal Soc.* 178A: pp 314-350. [Communicated by P.A.M. Dirac]

Bhabha H.J. 1941-42. "Cosmic radiation". *Summary of ten lectures delivered at Calcutta University*, December 1940. *Sci. Cult.* 7: pp 470-476 and 520-527.

Basu D. and Bhabha H.J. 1942. "The theory of particles of spin half and the Compton Effect". *Proc. Indian Acad. Sci.* 15A: pp 105-117 and Erratum on pp 461-463.

Bhabha H.J. 1942. "Radiation reaction in relation to scattering phenomena". *Proc. Nat. Acad. Sci.* 12A: pp 33-46. Reprinted in *Proc. Nat. Acad. Sci. A*, Vol. 12: pp 33-46.

Bhabha H.J. and Chakraborty S.K. 1942. "Calculations on the Cascade theory with collision loss". *Proc. Indian Acad. Sci.* 15A: pp 464-476.

Bhabha H.J. 1943. "Recent advances in the theory of fundamental particles". Presidential address, Section of Physics, 30th Indian Science Congress, Calcutta, 1943. *Proc. Indian Sci. Congress.* 30: pp 33-49.

Bhabha H.J. and Chakraborty S.K. 1943. "The cascade theory with collision loss". *Proc. Royal Soc.* 181A: pp 267-303.

Bhabha H.J. 1944. "Note on the separation of the electronic and non-electronic components of cosmic radiation". *Proc. Indian Acad. Sci.* 19A: pp 23-36.

Bhabha H.J. and Harish-Chandra. 1944. "On the theory of point particles". *Proc. Royal Soc.* 183A: pp 134-141.

Bhabha H.J. 1945. "Relativistic equations for particles of arbitrary spin". *Curr. Sci.* 14: pp 89-90.

Bhabha H.J., Aiyar S.V.C., Hoteke H.E., Saxena R.C. 1945. "Latitude effect for mesons". *Curr. Sci.* 14: pp 98-99.

Bhabha H.J. 1946. "The theory of the elementary particles". *Rep. Progr. Phys.* 10 [1944/45]: pp 253-271.

While at IISc Bhabha was working on a Monograph on Cosmic Radiation which was to appear as part of the Oxford International Monographs Series on Physics. The physicist and astronomer R.H. Fowler, under whom Bhabha had done his PhD at Cambridge, had written to him in February 1943 saying that he was confident that it would be 'the most important book which will play an important part in the development of the next step in theoretical physics'. Bhabha later expanded the scope of his project to include a separate monograph on 'Spinor Algebra'. The project remained incomplete. This is a page from his unpublished manuscript.

introduce chapter on matrices, perhaps say:
 Postulate vectors $e_1, e_2, e_3, \dots, e_n$ (10)
 Postulate sum of any two vectors commutative = third.
 If n and not more than n vectors exist such that for

$\sum c_i e_i = 0$ vectors independent then space called a linear space.
 It follows that all $c_i = 0$, for any other vector e_i (11)

$$e_i = e_j \cdot a_{ij}$$

where the a_{ij} are numbers.

An operator A turns every vector into another (12)

$$A e_i = a_{ij} e_j = e_j \cdot a_{ji}$$

a_{ij} are numbers.

Operators linear (13)

$$A(e_i + e_j) = A e_i + A e_j$$

P.T.O.

With every vector e_i associate a conjugate vector e_i^+ such that if e_1, \dots, e_n form an independent set, so do e_1^+, \dots, e_n^+ and that if then (14)

$$e_i^+ e_j = \delta_{ij} = 1 \text{ if } i=j, 0 \text{ if } i \neq j$$

and we postulate that the determinant $\Delta = |e_i^+ e_j|$ is not zero. We write δ_{ij} instead of 1 to distinguish e_i^+ from e_i which is different (15)

We further postulate that there exists for every i and j a number called their scalar product and denoted by (e_i, e_j) or $e_i \cdot e_j$ (16)

$$e_i \cdot e_j = \overline{e_j^+} e_i = e_i^+ e_j$$

$$\text{Then this } e_i \cdot e_j = \overline{e_j^+} e_i = e_i^+ e_j = \overline{e_i} e_j^+ = e_i^+ e_j^+ e_i e_j$$

P.T.O.

and since this holds for arbitrary vectors e_i, e_j (17)

$e_i \cdot e_j = \overline{e_j^+} e_i = e_i^+ e_j = \overline{e_i} e_j^+ = e_i^+ e_j^+ e_i e_j$

Sir Kariamanikkam Srinivasa Krishnan (1898-1961) FRS, physicist, had co-authored the discovery papers on the Raman Effect with Sir C.V. Raman. Krishnan played an important part in India's scientific development. When World War II prevented his return to England, Bhabha eagerly sought out the older scientist.

25.12.39 BHABHA TO KRISHNAN

Little India Rd.
Malabar Hill
Bombay
25- December '39.

Dear Professor Krishnan,

I came to India for my summer holidays as usual this year, and the outbreak of war has delayed me from going back. I have often thought of writing to you, but have put it off for a better moment and so some months have passed. I have deferred my return to Europe till the Spring, and hope to meet you before then. I have been asked to give a course of 25 lectures at the Institute of Science, Bangalore during January and February, but if I can get to the Science Congress at Madras before beginning my lectures, it might be an opportunity of seeing you. I should be very grateful to you if you would kindly give me some indication of your movement and the programme of the physics section.

With the greetings of the season and hoping to see you soon,

Yours sincerely,

H.J. Bhabha

In 1941, Bhabha sought Krishnan's advice about the Allahabad Chair in physics. Incidentally, Krishnan moved to Allahabad University where he headed the physics department in 1942.

SECRET BHABHA TO KRISHNAN

West End Hotel
Bengaluru
28 May 1941

My dear Krishnan,

I am writing to make some enquiries from you as a friend concerning the Allahabad Chair of Physics, and would ask you to keep the matter strictly private. Sir C.V. Raman is very anxious that I should consider accepting this chair.

There are, however, a number of things which make me pause for very serious considerations. Firstly, I find that if the climate is adversely hot, then my work suffers. I know that Allahabad has a very fine winter, but the summer is extremely bad. Secondly, I am only interested in research and not in teaching. I would therefore be prepared to undertake routine duties for at most six to eight hours a week. This is a point on which I would value your opinion. Are the teaching duties at Allahabad necessarily so great as to considerably overstep the limit mentioned above. If you could give me any indication of the time the routine duties would involve, I should be very grateful. Thirdly, I am about to embark on some big scale experiments in cosmic rays. I find that theory has come to the point when it requires confirmation or refutation, and we have already embarked on a few crucial experiments at this institute. I intend carrying out even larger scale experiments, but for this I feel even I can find money outside. The main point that concerns me is the equipment of the Allahabad laboratory; does it possess a good workshop with competent mechanics, glass blower etc.; is the general equipment of the laboratory good and is there ample room for research. Lastly, if you have any views of the abilities of the staff of the physics department, I should very much like to have them. You may rest assured that I will treat the matter as strictly confidential and not pass it to anyone else.

I would also value any other general observation you may make. You must have gone into the matter yourself as I know that the chair was offered to you also. May I request you to treat this letter as strictly confidential also?

I hope your work is progressing well. If you have any new remarkable results, I should be very happy to hear of them.

I am being pressed to make a quick decision, so I would value an early reply from you.

With kindest regards,

Homi J. Bhabha

Robert A. Millikan (1868-1953), physicist, won the Nobel Prize for physics in 1923 for measurement of the charge of an electron and for his work on the photoelectric effect. Millikan was president of Caltech from 1921 to 1945.

My dear Prof. Millikan,

It is a long time since I wrote or heard from you and this is no doubt because the war has been occupying all of us so much of late.

I saw your papers in the *Physical Review* about the results of your measurements in India, and was interested in them. I should be grateful if you would send me a reprint of these papers as also a reprint of the paper by Neher and Pickering in the *Review of Scientific Instruments* (1942) entitled 'Radio guide to cosmic rays.' This paper is not available in India at all because the number of the *Review of Scientific Instruments* containing it is missing from all the libraries, and was presumably lost in transit. We should deem it a special favour if a reprint of the latter paper could be sent by air mail.

As I wrote to you some time ago I have been contemplating carrying out high altitude flights in India at places in addition to those at which you did your beautiful experiments, and if possible with lead between the counters for measurements on the penetrating component. We are now starting work on these experiments in spite of the great difficulties due to the war. There are certain technical questions I would like to ask which might have been dealt with in the 'Radio guide to cosmic rays' mentioned above, but as this paper is not available here, I should be very grateful to you if you would answer them. I should like to have the following information:

- 1) Specifications and make of the clock used by you and the rate of transmission of pressure readings.
- 2) Specifications of the neon lamps and relays used.
- 3) Specifications of the recorders used.
- 4) The actual thickness of the glass used in your counter tubes.

It would save a good deal of experimentation in these days when apparatus is so costly if we could learn from the great experience of yourself and your co-workers.

There is also one theoretical point which is not clear to me. What is the ground for the statement in your paper that the minimum energy required for a ray to penetrate vertically to the magnetic equator in India is 17 billion volts? The longitude of India being 71-81 degrees E while the longitude of the displacement of the eccentric dipole being 161.8 degrees E the distances of a place in India from the eccentric dipole and from the geographical centre of the earth are very nearly the same. On this ground the usual Stormer formula would give the minimum energy for vertical incidence at the magnetic equator in India as 15 billion volts and not 17 billion volts. You probably have some other reason for your statement.

Millikan visited India between 1939-1940 to measure cosmic rays at high altitudes near the geomagnetic equator. He met Bhabha in Bangalore and they corresponded. Bhabha hoped that he would be able to visit Caltech but the war prevented that.

INDIAN INSTITUTE OF SCIENCE
BANGALORE, INDIA

I hope you have received the reprint of my paper with Chakraborty in the Indian Academy of Sciences in which accurate figures are given for the cascades produced by electrons of different energies at different depths, and the resulting energy spectrum in the cascade. These results are to my knowledge the most accurate that have been published so far. On investigation we find that the method of Snyder and Serber is mathematically defective so that no real confidence can be placed in their results, and in fact comparison with our results shows that they are very considerably in error. The full paper of my work with Chakraborty is appearing in the Royal Society and I have just returned the proofs. But Prof. K.S.K. Iyenger here has given (in the *Proc. Ind. Acad.* 15) a complete solution of the cascade problem taking collision loss and incompleteness of screening into account with the rigour of a pure mathematician, and in the course of his paper rigorously justified the solution we have used in calculating our numerical results. One result of our revised calculations is to bring the position of the maximum of the absorption curve in the atmosphere into even better agreement with your results than the previous work of Serber, but I have not gone into greater detail in comparing theory with experiment as you and your co-workers are in a much better position to do this on the basis of the figures given in my paper with Chakraborty. I should be happy to hear from you on this subject.

I hope it will not be long before we can all turn again in more favourable conditions to purely scientific activity. In the meantime please convey to Mrs Millikan my best wishes for Christmas and the New Year and accept them yourself.

Yours sincerely,

Homi J. Bhabha

CALIFORNIA INSTITUTE OF TECHNOLOGY
PASADENA

CHAIRMAN OF THE EXECUTIVE COUNCIL

February 18, 1943

10 (1/2)

Professor H. J. Bhabha
Indian Institute of Science
Bangalore, India

Dear Professor Bhabha:

I was delighted to receive your letter written December 8th, and also to know that you hope to make further experiments in India along our line. It will be most useful, I think, to do so.

I am sending you herewith ^{under separate cover} reprints of all the papers which we have thus far written, as you request, but we have a couple more papers that have been sent to the Physical Review which when they are out will be more interesting and more useful. The results reported in these papers are, in a word, that the checks that we get on the theory from the work in Mexico and in the United States constitute, from our point of view, convincing evidence for the correctness of the hypothesis, though for that matter the results which we obtained in India seemed to us fairly unambiguous in their implications. I sent in these two new papers at least a month ago, and I do not know when they will be printed, but I should assume that they will be out by the middle of March or the end of April. At any rate, we will send you reprints as soon as we get them.

Now, as to the four detailed questions to which you ask for answers:

1. We used just a cheap clock movement, the rate of transmission of the pressure readings corresponding to one cycle of eight minutes.
2. We used $1/4$ watt neon lamps and 2000 ohm coils for the relays.
3. We used home-made recorders, tape speed about 20 centimeters per minute.
4. For our counter tubes we used just as thin glass as possible, about $1/16$ th inch.

1641

You are probably aware that in the Lemaitre-Vallarta analysis of the energy required to push electrons through the earth's magnetic field at different latitudes they took the mean energy required to get into the earth at the equator as 15 billion electron volts. We took their value and combined it with our own measurements on the equatorial-longitude effect which showed an equatorial drop in the sea-level intensity of between 7% and 8% in going south from the temperate latitudes to the West Coast of South America, and 12% to 13% in going south at the longitude of Ceylon.

15 (2/2)

Combining these results with the Lemaitre-Vallarta mean^y of 15 we estimated the energy necessary to get in at South America at 13 billion electron volts and that of India at 17. That this could not be far from wrong seems to be indicated by the fact that the silicon rays had definitely not appeared in India at the latitude of Agra, but had appeared in full force in the latitude of Peshawar. Our new Mexican work gives further evidence that these results, although somewhat crudely arrived at, cannot be seriously wrong.

I want to tell you how much I appreciate your sending your paper with Chakrabarty, published in the Indian Academy of Sciences. I am also pleased to know that your newer calculations have brought the position of the maximum of the absorption curve in the atmosphere into better agreement with our results than did the previous work of Serber.

Our whole staff has practically stopped its fundamental research work and we are bending all our efforts here to war problems. Let us hope that it will not be too long before we can return to the normal activities of institutions of this type.

With best regards to you and all my friends in India, I remain

Very cordially yours,

Robert A. Millikan

Mrs. Millikan also wishes to be kindly remembered.

RAM:IM



IISc, 2nd February 1940.

Sitting: Mrs Sunanda Bai, Dr H.J. Bhabha, Dr K.R. Ramanathan, Dr H.V. Neher, Mrs Millikan, Prof. R.A. Millikan, Lady Raman, Dr W.H. Pickering, Prof. C.V. Raman, Dr M.A. Govinda Rau, Dr C.S. Venkateswaran



Middle Row: V.A. Sarabhai, Bishamhar Dayal, W.W. Joshi, T.M.K. Nedungadi, T.A.S. Balakrishnan, Dr B.V. Raghavendra Rao,
K. Anantanarayanan, C.L. Narayana Rao, N. Sreenivasamurthy, V.L. Talekar, P. Nilakantan, R. Norris.
Top Row: Sivasankaran, Rangaswamy, Hussain, Muniiswamy



Bhabha with Sir C.V. Raman at the Indian Institute of Science, Bangalore.

1681

Sir Chandrasekhara Venkata Raman (1888-1970) won the Nobel Prize in physics for his work on the molecular scattering of light named the 'Raman effect'. Raman became the first Indian director of the Indian Institute of Science in 1934. In 1939 when Bhabha joined IISc, Raman was professor of physics. Raman nominated Bhabha to the Royal Society. Bhabha's relationship with Raman remained cordial throughout.

Facing page: Bhabha's Certificate of Election to the Royal Society, 1942.

Attention is especially called to the directions given on the other side

Certificate of a Candidate for Election

Surname ^h ~~Homi Jehangir~~ BHABHA
 Christian Names ^h ~~Homi~~ HOMI JEHANGIR
 Profession Reader in Theoretical Physics, Indian Institute of Science, Bangalore
 Usual Place of Residence ~~Indian Institute of Science~~, Bangalore, INDIA

Not to
 exceed
 100
 words

Qualifications

B.A., Ph.D.(Cantab). Distinguished Mathematical Physicist. Has contributed notably to our understanding of cosmic ray phenomena, especially the atmospheric absorption of the rays, the origin of electron showers, the production of cosmic ray bursts by the penetrating component, and the radioactive decay of mesons. Has made important contributions to the theory of mesons and nuclear forces and has recently extended Dirac's classical theory of radiating electrons to spinning particles and meson fields. Has indicated the theoretical grounds for the probable existence of protons with multiple charges.

being desirous of admission into the ROYAL SOCIETY OF LONDON, we the undersigned propose and recommend him as deserving that honour and as likely to become a useful and valuable Member.

From General Knowledge

From Personal Knowledge

M. H. Newman
 K.S. Krishnan (A.C.E.)
 B. Sahni (A.C.E.)

C. V. Raman Proposer
 P.A.M. Dirac Secondor
A. Eddington
 Wilbress.

Elected 20 March 1941

Philip Francis Brown
 Assistant Secretary.

Suspended for 1941

J. G. Kennedy-Jones
Harold Jeffreys
 D.R. Hartree (A.C.E.)
 M.L. Oliphant (A.C.E.)
 M. Born (A.C.E.)

Delivered at the Apartments of the Society on the 20th day of November 1940
 Read to the Society in the 30th day of March 1941

TURN OVER

The Bhabha family had a relationship with the Mysore court as Bhabha's grandfather was the Inspector of General Education in Mysore. Bhabha shared with the Maharaja Jaya Chamaraja Wadiyar a love for music. Their relationship endured even after Bhabha left Bangalore.



223(11)

THE PALACE,
MYSORE.

12th July 1948.

Dear Dr. Bhabha,

I have read your letter dated the 15th June 1948, with great interest and I thank you for the suggestions therein which will receive my earnest attention in due course. I am happy that you share my admiration for the compositions of Medtner and I am sure you will appreciate equally well further works of Medtner which I hope to send you in due course.

I must thank also for the four post cards of the settings done by you for the Mozart's Opera Idomeneo and for the photograph of one of the pictures exhibited at the Indian Art Exhibition in London. The settings designed by you are not only very charming but also bring out pictorially the spirit of the opera. I am also greatly delighted with the photo exhibited by you at the Indian Art Exhibition.

1761

Yours sincerely,
Jaya Chamaraja Wadiyar

Dr. H.J. Bhabha, F.R.S.,
Director, Tata Institute of
Fundamental Research,
Mumbai Road, Bombay 26.

During his years at Bangalore, Bhabha sketched Raman. He also won Raman's admiration for being a modern Leonardo da Vinci.



'Bhabha is a great lover of music, a gifted artist, a brilliant engineer and an outstanding scientist... He is the modern equivalent of Leonardo da Vinci'.

Sir C.V. Raman at the Annual Meeting
of the Indian Academy of Science, Nagpur, 1941.

The Pleasures
of Exile

[9]

Bhabha and Dirac at
Bombay, during Dirac's visit
to TIFR in 1954.

Bhabha first met P.A.M. Dirac at Cambridge. During the war, Dirac encouraged him to apply for the Adam's Prize – a letter that had to be passed by the war-time censor. Bhabha won the Adam's Prize in 1942.



31-7-42.

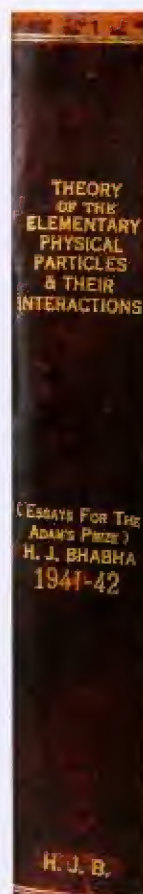
Dear Bhabha,

The Council of the Senate which met a few days ago has agreed to accept your essay for the Adams Prize provided it is despatched not later than December 31.

Will you register it when you post it, so that there will be evidence of the date of its despatch! The ordinary postmark might be illegible.

Also, as soon as you get this letter, will you please write to the Registry (address - the University Registry, Cambridge) saying definitely whether you intend to compete.

Yours sincerely,
P. A. M. Dirac



Meghnad Saha (1893-1956), FRS, astrophysicist, was best known for the theory of thermal ionization. Saha was an active member of the National Planning Committee of the Indian National Congress in 1938. He built several scientific institutions and founded the journal *Science and Culture*. The relationship between Saha and Bhabha began in a pleasant way but soured in later years as Bhabha became influential and powerful.

10.04.40 SAHA TO BHABHA

UNIVERSITY COLLEGE OF SCIENCE
DEPARTMENT OF PHYSICS

22, UPPER CIRCULAR ROAD
CALCUTTA

April 10, 1940.



Dear Dr Bhabha,

The Pleasures
of Exile

Thanks for your letter. I am sorry to know that you have got no reprints to spare.

I could not write to you earlier as the Fuhrer of the University was out on political work. I just phoned to him today and he tells me that the Syndicate has decided to invite you to deliver a course of lectures on cosmic ray physics from July 1 onwards on a remuneration of Rs 1,000. In addition you will get first class T.A. The official letter will come to you sometime later, because the formalities take some time to be gone through.

I shall be very glad if you can kindly accept the invitation. Myself and my students are very anxious to meet you and have full discussion on all matters concerning cosmic rays with you. I am drawing up for you a programme of lectures which we would like you to deliver here, but of course the choice lies entirely with you. Calcutta is usually wet during July, but being a Bombay man you cannot have much to complain of. We are thinking of going to Darjeeling in May to spend my summer vacation (May to June) there and also incidentally do some cosmic ray work. But unfortunately I have not been able to get some decent house. If I succeed in getting one, I shall write to you and I shall be glad if you can come and join us there. Darjeeling is one of the finest sites in the world and May is the proper month for seeing Darjeeling. In June it becomes sometimes too wet.

The European situation is very bad now and I am anxious for Prof. Bohr. I hope he has been able to slip out before the Germans reached Copenhagen. Being a half Jew he is sure to have difficulties with the Germans' occupation.

1741

Yours sincerely,

M.N. Saha

Prasanta Chandra Mahalanobis (1893-1972), FRS, was a scientist and applied statistician renowned for the Mahalanobis distance, a statistical measure. Mahalanobis founded the Indian Institute of Statistics in 1932. Like Bhabha, Mahalanobis was close to Nehru. He became India's key economist during the Second Five-Year Plan (1956-1961).

26.01.46 MAHALANOBIS TO BHABHA

Indian Statistical Institute,
Presidency College, Calcutta.
26 January 1946.

My dear Bhabha,

I had been feeling somewhat disillusioned and fed up with my own generation. Contacting you at Bangalore was a great pleasure.

I do not know whether you were wise in having asked me to give that lecture on 'India and the Russian experience'. I had no time to get anything ready. But I felt quite strongly about what I spoke. After my return, D. Mukherjee, who is in charge of the Indo-Soviet Journal, made me dictate a summary of the lecture which I believe has been printed. I had suggested that I should write out a short article not as a summary of the lecture but roughly based on it; and that they should ask you to write out in the same way something based on what you spoke at the meeting (which I liked very much and which would certainly be preserved in a permanent form). These two articles could then have been printed together. This can be done even now.

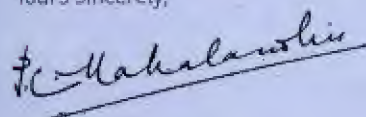
It was very kind of you to have asked my wife and me to the Rotary dinner. We were very glad to have had the opportunity of meeting your mother. It was very charming of her to have taken us to your house straight from the lecture and to have given us dinner before we went to the station. Please remember us to her.

It is good that we shall be both in the Indian delegation to the Empire Science Congress. I understand that the original list consisted of 12 names; and that your name and mine were added at the last moment. However, I am glad.

I do not suppose you are coming to Calcutta in the near future. If any odd chance brings you here you will of course let us know; and, if it suits your convenience, stay with us.

With kind regards,

Yours sincerely,

P. C. Mahalanobis

Birbal Sahni (1891-1949), FRS, paleobotanist, founded the Institute of Paleobotany at Lucknow. Bhabha and Sahni's relationship remained a close one. He was one of the few scientists to whom Bhabha wrote openly about his sense of loss after his father's death in 1943.

07.01.43 BHABHA TO SAHNI

MEHRANGIR, 12, LITTLE GIBBS ROAD, MALABAR HILLS, BOMBAY.

My dear Sahni,

I want to thank you for your wire of sympathy on the death of my father. I am sorry to have been so late in writing to you but I have been extremely busy. My father's untimely death upset my work for several months and I had to make up for lost time by working upto 1 and 2 every night up till the 29th December. I have now come to Bombay for a four weeks holiday.

Although it is today just six months since my father died, the passage of time has in no way lessened the acute sense of loss we feel at his death. Our family of four has always been so close that whether in work or in pleasure we constantly miss the presence of one who had hitherto shared everything with us. He was full of zest for life to the very end and although he was semi invalid for the last year and a quarter of his life due to an attack of coronary thrombosis, he was fortunately spared any pain or suffering. He was both an exceptional husband and an exceptional father, and I owe whatever ability I may have to the enormous pains he took to develop any talent I might have possessed as a child.

Thank you for your letter of the 4th October which I have also not replied to. It is very kind of you to offer to publish up to 250 pages of my lectures. I wish I could avail myself of the offer. Some five years ago before I came out from England, I had promised Professor R.H. Fowler to write a book on cosmic radiation for the series of international monographs on physics published by the Oxford University Press. I have kept putting off this book as I was engaged in some important research connected with the subject of the book till 1941. I have spent some nine months of this year either writing the book or collecting material for it, and about half of the book was sent off to Cambridge on the 29th December. This is the reason why I have been working so hard. The other half will be written this year. As this is a book I had promised some five years ago when I was a lecturer in Cambridge, you will understand that I would not give the material for publication elsewhere, and that it also precludes my writing anything else except on new researches, just now. It is only with the greatest unwillingness I wrote 15 pages for my presidential address for the Physics section of the Science Congress. I was asked to deliver the Sukraj Rai lectures by Patna University and 3 lectures by Bombay and in both cases I replied stating my inability to write anything for them. Bombay University have nevertheless asked me to deliver the lectures on the understanding that nothing need be written at all. I hope you will therefore understand the difficulty of my writing up anything for publication by Lucknow University. I should really have been happy to oblige you as a friend but there is nothing I can write besides what has already been published in my papers from time to time or appear in the book mentioned above. I am sorry the Science Congress was not held at Lucknow. I had spent some precious time organizing two discussions which I had hoped would have been useful for workers in this 'line'. It is a pity the Congress was not postponed for some months instead of being held in such difficult circumstances.

With kind regards and best wishes for a Happy New Year to you and Mrs Sahni.

Yours sincerely,

H.J. Bhabha.

Harish-Chandra (1923-1983), FRS, mathematician had worked on representation theory, especially Harmonic Analysis on semisimple Lie groups. Harish-Chandra was at IISc during the war years and worked with Homi Bhabha. In this letter, a page of which we reproduce, he enquires about their joint publication. He also confesses his increasing interest in pure mathematics and his desire to switch over once he has 'learnt enough of it'.

20.10.45 HARISH-CHANDRA TO BHABHA

BY AIR MAIL

AIR LETTER
IF ANYTHING IS ENCLOSED
THIS LETTER WILL BE SENT
BY ORDINARY MAIL.



17 (1/2)

6 Brookside
Cambridge
Oct 20, '45

Dear Professor,

Thank you for your letter of the 28th Sept which reached me about ten days ago. I am thankful to you for making the proof of my paper the Sept number of the Royal Society has not come out as yet. I hope my paper will be in that.

I went and saw Mrs. Price with your letter one afternoon.

As far as I can see the expression given in my paper is all right. The relevant equations are as follows

$$\begin{aligned} \left(\frac{1}{2}K\right)_r + \left(\frac{1}{2}K\right)_r = & - \left\{ 2\dot{K}_r + 5\left(\frac{1}{2}K'' - \frac{1}{2}K(VV)\right) + 2K'\dot{V} + 2K\dot{V}, \right. \\ & + 5\left(\frac{1}{2}K'K'' - 2KK'(VV) + \frac{1}{2}KK'' + 2K^2(VV)\right) \\ & \left. + 5\left(\frac{1}{2}K\dot{V}'' - 2K^2(VV) + 2K^2\dot{V}\right) + 4K\dot{K}'\dot{V} + \frac{1}{2}K'\dot{V}^2 \right\}_r \quad (37) \end{aligned}$$

$$2\partial_p(KR)_r \rightarrow 2\partial_p(R)_r$$

$$2\partial_p(KK''R)_r \rightarrow -2\partial_p(VV')_r R_r \quad (37b)$$

$$2\partial_p(K^2R)_r \rightarrow -2\partial_p R_r$$

The 3rd term in $-\partial_p \partial_p \left(\frac{1}{2}K\right)_r$ is $-\frac{1}{2}g_{rr} \{ (VV)\dot{V} + V^2\dot{V} + \dot{V}^2 \}$ as given in (3-12). I might have made a mistake in taking in the formulae in the typed manuscript.

I don't know anything about my National Academy paper as yet. Is its publication still not in sight, is it possible to take it out from this and put it over to the British Academy?

Though this is still some formalities to be gone through about my admission as a research student to the University, Prof. Dirac has consented to be my supervisor for his three years. I am attending his lectures on quantum mechanics. His use of Superscripts and Subscripts sounds rather annoying at first but one soon gets used to it. The notation has no doubt great advantages. I am also attending all advanced lectures in pure mathematics. They deal with 'Theory of numbers', 'Functions of a real variable' and 'Linear Algebra'. At present there is practically no theoretical physicist in Cambridge except Dirac. He has left last year for some other job in London.

I am getting more and more interested in pure mathematics and perhaps I have learnt enough of it I might change or quit.

Wolfgang Ernst Pauli (1900-1958) theoretical physicist, won the Nobel Prize for physics in 1945 for the discovery of the exclusion principle also called the Pauli principle. Bhabha and Pauli met in Zurich in 1932. They corresponded regularly and met at conferences.

14.08.42 PAULI TO BHABHA

THE INSTITUTE FOR ADVANCED STUDY, PRINCETON, NJ

Dear Bhabha,

I received your letters of 2nd May and of 12th May and also the separate copies, many thanks. My paper with Dancoff will appear this month and I shall send you then a separate copy. With your new statements about the Klein-Nishina formula in the theory of holes I agree completely. We have the *Indian Academy Proceedings* in the library of the Institute and I hope to read the papers about the Cascade theory if I come back there from my summer vacations in about three weeks.

The Pleasures
of Exile

I was very interested in Dirac's new attempt (*Proc. Royal Society* March 1942) to find a reasonable way of translation of a Classical field theory into a quantum theory without losing the relativistic invariance and without introducing singularities. With great efforts I have at least partly understood Dirac's idea and have exchanged two letters about it with him. I intend to work out some examples and shall write about it again. It is urgent to have a suitable translation method into quantum theory, which would hold also for your (1941) meson theory. I hope to come back to this topic in a subsequent letter.

Physics is going to be more and more reduced in this country in favour of military work. It is not a pleasant time and nobody can predict how long the war will last.

Meanwhile best wishes from Mrs Pauli and me.

Sincerely yours.

Pauli.

04.06.43 BHABHA TO PAULI

Dear Pauli,

1781

I am sorry that it is almost exactly a year since I wrote to you. In the meantime, I have to acknowledge your letters of the 14th August 1942 and 16th March 1943, both of which I was very glad to get, as also the Xmas card from you and your wife, for which please accept my thanks. The reason for my not having written so long is due to the fact that I lost my father in July last year, and this was a great blow to my family who had always been in the closest touch with each other. After that I was very busy with the writing of my book, which has now become a book, not on cosmic rays, but on the elementary particles of nature and their interactions. In this connection I have also been studying your book on Einstein's general theory of relativity, and have been wondering whether it is not time that a serious effort was made to introduce gravitation and modern quantum theory into one unified

During the war when Pauli moved to the United States of America, he had written to Bhabha that had circumstances allowed it he would have liked to invite him to the USA. Their friendship endured and Pauli visited TIFR in 1952.

scheme. This is however by the way. I have written about 350 (typed) pages of the book and hope to complete it by the end of this year.

Coming now to your letter of the 16th March, I do not quite follow your arguments regarding the work of Christy and Kusaka. Chakraborty has calculated the production of showers and bursts by mesons using (1) our new results for the cascade theory, and (2) assuming mesons of different spins. For spin 1 he has taken the radiation cross-section as given by Wilson (*Proc. Camb. Phil. Soc.* 1942). He definitely finds that spin 1 cannot be excluded by the experiment, and that, if anything, it is in better agreement than other values of the spin. I have myself checked the analysis and found it correct. Chakraborty is a very conscientious worker, and I have confidence that his numerical computations are correct. If you can find any objection to Chakraborty's work, I shall be glad to hear it. Failing this, I think I should be justified in maintaining that these experiments, any way, do not exclude the mesons having a spin 1. (Chakraborty's paper is published in the *Indian Journal of Physics* 16, (part 4) p. 377-392, 1942.)

I am now on a well earned holiday in Dotacamund, and cannot answer some of the points raised in your letter of the 14th August since I have no books or papers with me here. I shall answer that letter on my return to Bangalore. The climate here is lovely and the change has done me a lot of good. It is cold enough to sleep under two blankets and an eiderdown, which is unusual for India. I have started a landscape and hope to finish it before I leave. This place is 7500 feet high and the country is really beautiful with lovely views. I have also been doing a lot of drawing.

The war news seems to be better at last, and I think one may optimistically hope that the war will end within a year. I have now a cosmic ray laboratory, and we have had the greatest difficulty in obtaining apparatus. But we are at last in a position to do some important experiments. We are going to do some high altitude balloon flights to study cosmic radiation in the stratosphere.

I shall write to you again soon after my return to Bangalore. In the meantime, I send you and Mrs Pauli my regards and best wishes. If you complain about being isolated in America, you can imagine what it is like in India. There is not a single person with whom I can talk about any fundamental theoretical problem. Your letters, therefore, apart from the fact that it gives me great pleasure to be in touch with you personally, are very much appreciated, and I hope you will continue to write frequently. Please forgive my long silence this time, which as I mentioned above, was due to sad personal reasons.

Yours sincerely,

Homi Bhabha

Maurice Pryce (1913-2003), theoretical physicist, had an outstanding career at Cambridge in the early 1930s when Bhabha was there. He contributed to new Field theory. He worked with Sir Ralph Fowler and later the Nobel Laureate Max Born. In this letter, Pryce sent Bhabha the announcement of the Wykeham Professorship and encouraged him to apply. He wrote: 'I think it would be very good for English theoretical physics if you would return to England'. Although he modestly referred to himself as not providing serious competition to the post, Pryce himself was invited to the Wykeham Chair in 1946.

11.08.45 PRYCE TO BHABHA

C/O NATIONAL RESEARCH COUNCIL, P.O. BOX 159, STATION H, MONTREAL, CANADA

The Pleasures
of Exile

Dear Bhabha,

The above is a copy of an announcement in the Oxford University gazette which was sent to me recently. I hope that you will consider applying for it, as I think it would be very good for English theoretical physics if you would return to England. I myself have also sent in an application, but I do not think my competition would prove serious. As you no doubt know, Wilson has given up physics for industry, and the number of competent theoretical physicists in England is lamentably small compared with the need for building up a sound school.

Since 1941 I have been out of touch with physics. I spent three years at Admiralty Signal Establishment on Radar, and am now working with Cockcroft at Montreal. I have seen, but not read, some of your recent papers, and am looking forward to a programme of reading when I return to Cambridge, when I have got a lectureship. I am picking up a few threads here, the work is definitely physical, but I don't have much time for serious research.

I received a letter from you some years ago, for which many thanks, and I am sorry I was too lazy even to reply. I hope I shall be seeing you again soon. Congratulations on the honours which have been conferred on you.

Yours sincerely

Maurice Pryce

CANADA

AIR LETTER
PAR AVION

Sir John Douglas Cockcroft (1897-1967), FRS, worked with Ernest Walton on the acceleration of protons at the Cavendish laboratory; they shared the Nobel Prize for physics in 1951. Bhabha first met Cockcroft in Cambridge and their relationship continued through the war years that Bhabha spent in Bangalore. After the war, Cockcroft organized the construction of the first heavy water reactor to be built in Chalk River, Canada. Later, he became the director of the Atomic Energy Research Establishment in Harwell, United Kingdom. Bhabha sent scientists from TIFR and AEET to Chalk River and Harwell for training. Cockcroft visited both the institutions that Bhabha built.

05.07.45 COCKCROFT TO BHABHA



**NATIONAL RESEARCH COUNCIL
CANADA
Montreal Laboratory**

My dear Bhabha,

I was delighted to receive last week the collection of your reprints. This coincided with my first week's vacation for some long time and I have been sitting in the sun in the Laurentians reading them.

For the last 5½ years I have read very little physics, being occupied until a year ago with Radar development and its application to the urgent needs of the war. Most of the 1939 Cavendish research group were occupied in this way and took the leading part in the application of Radar to defeating the U-boat war, to the bombing of Germany and to the defence of Great Britain against air attack.

We are now able to think again of nuclear physics and have to catch up with five years of publications. So I was very interested in your address to the 30th Indian Science Congress and its speculations on mesons of different rest masses, protons of negative charge and so on. The recent publications from Urbana are of interest here.

We are expecting about 70 per cent of the Cavendish staff will return by October next, with a few such as myself, having to stay away a little longer due to Japanese war occupations. We hope to get a good research group in nuclear physics going again between October '45 to October '46. This will include Burcham, Dunworth, Shire, Devons, Ward and, possibly Bretscher. We are improving the cyclotron, building a 5 million volt pressure generator to provide us with a monokinetic neutron source of high intensity, and considering obtaining a betatron - this will have possible interest in meson work and will certainly be interesting for photo excitation and fission.

Pryce is probably returning to Cambridge to take Wilson's place. No appointment is being made at present to replace Fowler but in this case I hope we shall have visiting theoreticians in lieu.

I hope that you will be able to come over and spend one or two terms with us when we are all back.

Yours sincerely

J.D. Cockcroft

Archibald Vivian Hill (1886-1977), CBE, FRS, physiologist, is associated with the foundation of biophysics and operations research. He won the Nobel Prize for medicine in 1922 for elucidating thermal changes associated with muscle function. Hill visited India in 1944. It was during his visit that Hill conferred the FRS on Sir Shanti Swarup Bhatnagar and Homi Bhabha. He also advised Bhabha about his new Institute.

03 ON 36 HILL TO BHABHA

GOVERNMENT OF INDIA, DEPARTMENT OF EDUCATION, HEALTH AND LANDS, NEW DELHI

Dear Bhabha,

Thank you for your letter of 28th March, which reached me just in time as I am leaving on Wednesday. I will give your messages to Dirac, Fowler and Blackett and will tell Bernal what you say. No doubt many of your other friends in England will enquire about you when I meet them.

The Pleasures
of Exile

Saha told me that there is some possibility of getting Chandrasekhar back to India. I hope very much that he can be drawn back: you are not so rich in such people that you can give them away to America. A time there, however, will have been good for him. Thank you for your analysis of the results of the reference to the fellows of the N.I.S. There would seem to be no reason for not getting on with the items in which there is such general agreement – though funds will be wanted for the move to Delhi.

The party going to England in May will apparently be made up of Bhatia, Bhatnagar, Ghosh, Mitra and Saha. It should do a lot of good and I am sure that there will be much interest taken in it.

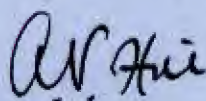
I have had an extremely interesting time here and my welcome has been beyond anything one could have anticipated. It has been a particular pleasure to get to know you and I hope that we shall have many opportunities of seeing each other again.

I have just had a letter from Blackett, dated 14 March, in which he refers to the possibility of getting Indian scientists into operational research, which is apparently under consideration in his part of the organization. I hope to see him before long, we shall have a lot to talk about.

With best wishes and au revoir,

Yours ever,

1821



AV Hill



Bhabha launches a balloon at Central College Bangalore. A.S. Rao and Vasudevachar are also seen.

Gustav Victor Rudolf Born (b. 1921), FRS, FRCP, is Emeritus Professor of Pharmacology King's College, London and Research Professor at the William Harvey Research Institute at St Bartholomew's Hospital, London. He came to know Homi Bhabha through his father, Max Born. Posted to India during World War II, he visited Bhabha frequently in Bangalore and Bombay.

I remember Homi Bhabha very clearly. I remember his round, open face, his gracious manner; his (left?) shoulder tick. I remember his quick responses; openness; bright comments; personal tolerances and friendliness up and down the Indian social divisions. He was much too big a person to invalidate the servants who adored him. I stayed with him in Cunningham Road, probably twice between early 1944 and mid-1945. The bright, big bungalow remains vivid in my memory. You approached on the drive and there were wide portals – a wide view into his wide, high living room study. And, Mussolini-like [it's the only likeness!]. Homi sat behind the desk many paces away from the entrance.

For this young, quiet and shy British Army Medical Officer there used to be endless fascinating talk. It was usually about art. I recall he painted well – I have the ivory portraits of his paramour in my vision now! They also talked about politics and the war. My parents and his family were very close. I stayed with them on Malabar Hills on first landing in India in

December 1943. That is another, indelible set of memories: the very fine mother; a delicious Parsee girl with whom I could have fallen in love. I still have her portrait photo. And Jamshed used to always brightly tease his mother.

During my entire three-year war time journey through the Far East, I had my flute with me. I had become a passably good flautist by the time I got my medical degree in Edinburgh. Well, one evening the Bhabhas gave a musical party in their splendid Bombay home. I usurped one of the two violin parts in the Bach D Minor Double Concerto, the other part being played by the delightful leader of the Bombay Symphony Orchestra by the name of Mehli Mehta. He had brought his charming wife and their almost new-born son. And so I was introduced to Zubin Mehta, at the very outset of his admirable career, at the Bhabha house.

After the war I think I met Homi once in London or Oxford. He had perhaps come to a physics conference and to see friends. One great friend was my cousin Otto Königsberger, for many years architect to the Maharaja of Mysore. He was brought to Delhi by Nehru to work on refugee resettlement after the partition crisis and to build the industrial city of Jamshedpur. He and Homi had been close for many years. It could well have been Otto who first phoned me about the Mont Blanc disaster – I remember being shattered, as were my parents – and indeed all who knew, loved and admired Homi.

G.V. Vasudevachar (b. 1924) joined as Homi Bhabha's first Laboratory Assistant at the Cosmic Ray Unit at the Indian Institute of Science. He later moved to TIFR.

GVV: Bhabha used to come and we used to do experiments. At that time there was a plane called Dakota – single engine. And we used to send telescope and Geiger counters in the plane for high altitude studies. We used to go to the HAL airport and we used to take the telescope there to the plane – and after the plane came back we used to bring back the equipment. We used to mount lead pieces in telescopes – we used to use Geiger counters. You have seen that photo of Bhabha and myself with A.S. Rao? There we had mounted lead pieces only.

IC: When Bhabha started TIFR – did he ask you to move to Bombay?

GVV: Yes. When Bhabha wanted to start TIFR in Bombay, he called me to his room and asked, 'Vasu, I would like to take you to Bombay. Would you like to come?' I could not give an answer, I said, 'Sir, I will ask my father and tell you'. My father told me, 'When Bhabha is asking – why can't you say 'yes', why ask me?' [Laughs]. I told him, 'Sir, I don't know Bombay, I am a new man, I have no accommodation'. He said, 'Don't worry about it. I will look after that.'

IC: So where did you stay?

GVV: I stayed in Kenilworth. Bhabha said,

"You stay here only, don't go anywhere."

His aunty used to take care of us very well, she was very kind. And after my marriage, she gave me a place to stay with my wife in the outhouse.

R.V.S. Sitaram (b. 1926) joined TIFR in 1947 after completing his MSc from Banaras Hindu University. Sitaram worked on the properties of cosmic rays, particle detectors, high speed electronics for Radio Astronomy and other programmes at the Institute. He subsequently became the founding director of Society for Microwave Engineering and Research (SAMEER) set up under the Department of Electronics in 1978.

IC: How did you come to apply for the TIFR post?

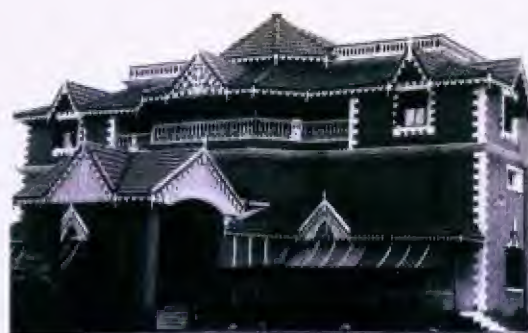
RVSS: I saw an advertisement in the papers and applied.

IC: What kind of post was it? What kind of position was advertised?

RVSS: It was only for students that's all – polytechnic students.

IC: And you got called to the interview?

RVSS: Yes. Dr Bhabha called me. The interview was in a hotel – Westend Hotel, in Bangalore. You see, I was in the south, perhaps Dr Bhabha thought it would be easier to ask me to come to Bangalore.



Homi Bhabha often visited the Westend in the evenings when he was staying at Bangalore. He also stayed there whenever he visited the city on holiday or work.

Left: The Westend Hotel, Bangalore, c. 1940s.

Facing Page: Homi Bhabha c. 1940s.

IC: And only Dr Bhabha was there at the interview?

RVSS: Yes. His mother was there in the suite, so during the interview, he would sometimes go and talk to his mother. But he gave me problems and asked how I understood them.

IC: So what kind of problem did he give you?

RVSS: He asked about the fundamentals of the Schrödinger equations and questions on quantum mechanics, and particles like electron, positron annihilation. He asked me what concepts I had, what is the theory of the positron – that was a new discovery at that time.

IC: Did you find Dr Bhabha approachable?

RVSS: Yes he was approachable. He was helpful. He helped me clarify many ideas too. I also learnt during the interview.

N.B. Prasad (b. 1928) graduated in Mechanical Engineering from the College of Engineering, Madras and then did a

Masters in Chemical Engineering from the USA. He joined the Atomic Energy Establishment in 1954, and later became a Project Manager (India) for the Canada-India Reactor. He was the chairman of the ONGC.

I was singularly fortunate to know Dr Bhabha and to work closely with him for seven years from 1954 to 1961. My first meeting with Dr Bhabha was in March 1954 at the Westend Hotel in Bangalore. One evening during my stay there, I spotted him sitting at a table on the lawns and introduced myself. I told him that I was working with an MNC in Calcutta, where I was grossly overpaid and very much underworked. He laughed and enquired about my qualifications. He assured me that I could find challenging work at the Atomic Energy Commission in connection with Asia's first nuclear reactor, but also cautioned that the salary would be much lower. He struck me as an informal and pleasant person without any superior airs or sense of undue self-importance. He appeared to be certainly a man one would like at first sight. My career with AEC began with this informal encounter with its Head.



5. JEH AND RUS

BOMBAY HOUSE,
FORT, BOMBAY.

1913 | JRD TATA JOINS TATA & SONS AS AN UNPAID APPRENTICE AT AGE 21

1931 | JRD TATA FLIES FROM KARACHI TO BOMBAY PAVING THE WAY FOR CIVIL AVIATION IN INDIA

1938 | JRD TATA BECOMES CHAIRMAN OF TATA & SONS



'A booster in the form of foreign collaboration can give a plane an assisted take-off, but it will be incapable of independent flight unless it is powered by engines of its own. If Indian industry is to take off and be capable of independent flight it must be powered by science and technology based in the country'.

Homi Bhabha, 'Science and the Problems of Development', 7 January 1966.

The idea of starting an institute of fundamental research had first struck Homi in 1943 and he had received a most encouraging response from his friend, the industrialist J.R.D. Tata. Jeh had written back: 'If you and some of your friends in the scientific world will put up concrete proposals backed by a sound case I think there is a very good chance that the Sir Dorabji Tata Trust will respond. After all, the advancement of science is one of the fundamental objectives with which the Tata Trusts were founded, and they have already rendered useful service in that field. If they are shown that they can give still more valuable help in a new way, I am quite sure they will give it their most serious consideration'.

It was Jeh's wholehearted encouragement that gave wings to Homi's dreams of institution-building. Homi would never tire of recalling the role played by his friend and the Sir Dorabji Tata Trust. Indeed, Jeh was involved with the Institute from its inception. He visited it often and remained involved with every aspect of its activities.

Homi had also another supporter – as sharp and as quick-witted as his friend Jeh – who would argue Homi's case before the Trust. A Professor of Latin and English at Wilson College, Bombay, Rustum Choksi was



Rustum Choksi, J.R.D. Tata, Homi Bhabha and Prime Minister Nehru, during the inauguration of new buildings, TIFR, 15 January 1962

the key figure behind the reconceptualization of the Trust policy on 10 April 1944. He saw the Trust as rendering useful services to society by 'initiating and maintaining projects of a pioneering character'. He argued that Bhabha's proposal should be supported to the hilt. Reiterating the vision of the industrial house the Trust was born out of, Rustum Choksi saw Bhabha's proposal as ushering in a new form of institution-building which was historically necessary, for it would contribute immensely to nation-building.

Jeh and Rus

Rustum Choksi remained a staunch supporter of Homi's Institute – visiting frequently and helping with administration in the early days. When Homi was travelling it was Rus who came and interacted closely with the scientists, offering advice and administrative support. He became a member of the Institute's Council and continued to play a supportive role to the Institute and its members even after Homi was gone.

1921

Left:
 J.R.D. Tata's invitation
 to Homi Bhabha on the
 occasion of Le Corbusier's
 visit to Bombay, in May 1953.

Opposite Page:
 Homi Bhabha and J.R.D.
 Tata in discussion, c. 1960s.



T. L. F. R.
H. J. BHARHA
NO. 617
DATE 8/4/53
85

72/16
1953
BOMBAY HOUSE,
FORT, BOMBAY, I

6th April, 1953.

Rustum Choksi (1902-1986), Professor of Latin and English at Wilson College, Bombay was a trustee of the Sir Dorabji Tata Trust. 'Rus' as he was called by friends, provided enthusiastic support and astute advice which enabled Bhabha to build his Institute. He refers here to SDS or Sir Sorab D. Saklatvala, JDC or J.D. Choksi, his brother, JJB or Jamshed Jehangir Bhabha, Bhabha's brother, JT or Jeh Tata, D or Ardeshir Dalal, M or John Mathai and also the RT Trust or the Ratan Tata Trust.

17.02.44 RUS TO HOMI

My dear Homi,

Jeh and Rus:

The bread, as you know by now, was well and truly delivered. Turning to lesser things, I think you should now submit a scheme to the Trustees. Send it along with a letter to Sir S.D.S. in which you may suggest it is for his consideration; that you'd have liked to put it to him in person; and that I'd written to you to send on the scheme. You'd be glad of any suggestions, modifications. Pile it on a bit! If he felt it could be submitted to his colleagues, would he do so, please? Point out it is an expression of work in hand, suggest Trustees need not commit themselves for more than 5 years. Hint that it may be later joint effort of Trust, Board of S and IR and Univ. Your letter should be personal. Address the scheme to the Chairman, Sir Dorab Tata Trust. Better still, though it may waste time send the scheme as a draft only and say that you will send it formally to him when you've received his opinion.

I would urge, keep the total of recurring expenditure at Rs 42,000 per year. It will grow. You will, of course, enlarge as you think fit from the need for such research, point out Bombay's backwardness, deep water experiments; and all else that's cogent. Suggest you don't name it, or call it an Institute for the present. Inst. sounds big to some. Have seen bosses D, T, S and M in that order. 3rd and 4th somewhat non-committal. Following algebraic symbols denote re-action in the same order - b+, a, c+, c. All the details you shall have later - perhaps, in person. May suggest in your letter that you'd come to Bombay to unfold, explain to Sir S and co-trustees, if they wish. Raise also question of cost and transfer of present equipment; and housing. Wonder if you can bring in R.T. Trust for that. Will see what J.D.C. says.

I hope you can follow this faintly incoherent series of points. I think you'll understand that I'm not directing just how you should shape it. May add that all are well aware you've something unusual, to be proud of - and something should be done. On p. 4 are more suggestions; they're no more than that. You know best. I feel that something low in the forties will not mean heart-throbs. Don't sketch the costs for the next year and the next. They ought to know that everything grows.

1941

Am showing this to JDC and JJB: they can vet it - the blighters. You needn't regard this as a letter, and I'll write again.

Yours Rustum.

SUGGESTIONS FOR SCHEME

	Per month
1. Director or Head of Dept. -----	1200
2. Reader -----	400 (or 350)
3. Research men -----	400

4. Studentship -----	200
5. Clerical staff -----	200
6. Maintenance -----	1000
7. Miscell. -----	100

	3500

Item 1) May strike you as low, or low-down. But I'm looking at it in relation to Univ. stds. here; and heart-throb. 2) Should be enough at present. Can you scale down (6) maintenance at present.

P.S. Just shown this to JDC who approves. He has in mind the point about getting help from the R.T. Trust. In your letter to Sir S. do suggest [JDC says] or inquire whether Sir R.T. Trust can help for equipment and building.
R.

26.12.44. RUS TO HOMI

My dear Homi,

Am sorry this five-year business has proved disturbing. Please set it right out. I haven't said a word about it in my four talks here. It came as an after thought when discussing things with Jamshed. A sop to Cerberus. Let it go to Hell, where Cerberus is.

But do send only to SDS for the present. It is just possible that if J.T. receives a copy, or mentions it, your stock may sink a trifle with S. On the other hand I'm fairly certain that J.T. will respond splendidly without any preliminaries. So cut out the time factor altogether. Take it for granted that things just go on, and emphasize that you'll stay in India, and plan to build up something big. Say what you've said about these short-term uncertainties. Suggest that later for fuller development, Univ and B.I.S.R. may play their part.

I am sorry if this 5 year biz has damped and perplexed.

Ruskin Choksi

A humorous exchange between J.R.D. Tata and Homi Bhabha about the codes of behaviour of scientists and industrialists.

24.03.44 HOMI TO JEH

2 CUNNINGHAM ROAD, BANGALORE

My dear Jeh,

I have sent a letter to the Chairman of the Sir Dorab Tata Trust with a scheme for the foundation of an institute of advanced physical research in Bombay which will no doubt come to you in due course. I must explain that I wrote the letter with a good many blushes, but in order to put forward convincingly a scheme which I believe to be in the interests of science, I have had to throw modesty to the winds.

Jeh and Rus

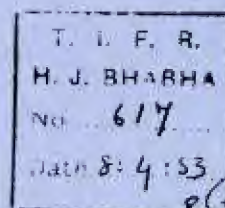
The labour however has set me thinking in a philosophical vein, and I have been amused to note how different are the codes of behaviour in different professions. For example whenever I have reason in my papers to refer to my previous work, I sometimes write 'The Author has proved that...', but more usually I write 'It has been proved (...) that...' and give the reference to the paper in question in brackets. But if a scientist says that he has produced the theory of this or that phenomenon, or indeed, the only correct and accepted theory, people immediately begin to think that he must put on his hat with a shoe horn. And yet no one is the least startled if a business man says that he produces the best beer in the world or the best soap. Indeed, he may proclaim it on a board fifty feet by a hundred and ruin the beauty of a mountain landscape, but few people think of it as immodest. Such is the relative nature of our moral codes.

Perhaps it is as well that scientists labour under this code of impersonality and modesty, for otherwise the view of visitors to this (ICRS) hotel might conceivably be distracted by an enormous board fifty feet by a hundred on the dam opposite with the words 'Raman Effect - greatest scientific discovery of this world'.

With best wishes,

Homi

1961



6

BOMBAY HOUSE,
FORT, BOMBAY.

April 5th, 1944.

My dear Homi,

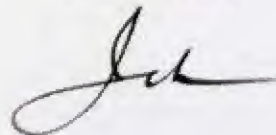
I am sorry I did not reply earlier to your letter of the 24th March, on the subject of the scheme you sent to Saklatvala for the establishment of a Physics Research Institute in Bombay. It is at present under circulation with the Trustees and will be discussed at their next meeting. You don't need to blush too much about what you wrote in your letter. As hardened business men we are not easily shocked by such mild forms of trumpet-blowing! *In fact it was almost mandatory!*

The answer to your philosophical wanderings into the difference of ethics between the various professions seems to me a simple one. Industry is not a profession and there is nothing personal in the advertising of his product by an industrialist. It is the former and not the latter that is boosted, while the professional man could only advertise himself. The ethical code of a manufacturer should prevent him from exaggerating or lying about his goods in his advertising, not from advertising at all.

As a matter of fact, the scientist does advertise in a subtle way when he puts a lot of letters after his name, such as "F.R.S.", and when he publishes his discoveries!

I think you are crediting Raman with undue modesty. His advertisement would be on a much bigger hoarding than 50 ft. by 100 ft. and would proclaim that the Raman effect was the greatest scientific discovery of the Universe - not merely of the world!

Yours ever,



Professor H.J. Bhabha, F.R.S.,
BANGALORE.



1981

TATA INSTITUTE OF FUNDAMENTAL RESEARCH
APOLLO PIER ROAD, BOMBAY 1

Dr. H. J. BHABHA, F. R. S.
DIRECTOR

TELEGRAMS: ZETESIS
TELEPHONE: 35058-59

Ref: DIR/Per-JRDT/1924

CHAIRMAN'S OFFICE
9 - JUL 1954

By des /ph,

You will be pleased to know that Professor P.A.M. Dirac, Nobel Prize winner in Physics and Lucasian Professor of Mathematics in the University of Cambridge, the Chair once occupied by Newton, is to spend four months at the Institute from the 1st of November this year. He is, in my opinion, perhaps the greatest physicist of his generation (Einstein being of the previous one). Between the age of 24 and 28 he became one of the architects of modern quantum theory, being the sole originator of the quantum theory of light and the relativistic equation of the electron, probably the most significant advance in modern theoretical physics.

I enclose a cutting about Dirac. It is an ill wind which blows nobody any good!

J.R.D. Tata, Esquire,
'Bombay House',
Bruce Street,
Bombay 1

Encl:1

This Page: As chairman of the Trust, JRD Tata took a great interest in meeting the visiting scientists. He congratulated Bhabha for having invited Dirac to his Institute in 1954. **Opposite Page:** Bhabha introduces Niels Bohr to JRD Tata as Jamshed Bhabha looks on, 1960.

*Computations! I am delighted.
What is the arrangement with
him? J.R.D.*

6 July 1954

*S. M. Bhabha has
seen.
File. 16/1954*

Jeh the industrialist remained a partner in science. Through his involvement in Homi's Institute and as a member of the Atomic Energy Commission, Jeh created a significant connection between industry, the scientific establishment and the government.

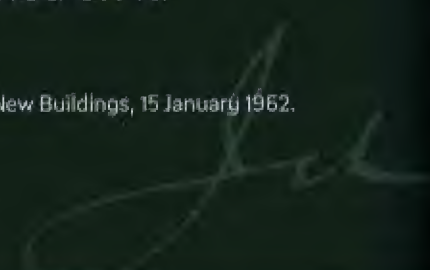
Jeh and Rus

'Tall oaks do not from all little acorns grow, but if this acorn planted some seventeen years ago, is now such a tall and sturdy oak, it is mainly because of the encouragement and generous support it has received from the Government of India, thanks to you, Sir. For that we are deeply grateful, as we are also to the Government of Maharashtra and its predecessor the Government of Bombay, who joined Tatas from the very beginning as co-sponsors of the Institute and have borne their share of burden ever since.

11001

While this Institute has benefited much from the generous support it has received and from the large funds placed at its disposal by the Government over the years, I venture to claim, on its behalf, that the services it has rendered to Indian science, and to the country as a whole, have been fully commensurate with the effort and funds lavished on it.'

An excerpt from J.R.D. Tata's speech at TIFR Inauguration of New Buildings, 15 January 1962.





Jawaharlal Nehru, Homi Bhabha, J.R.D. Tata and
K. Chandrasekharan at TIFR, 1962.



6. AN INSTITUTE IS BORN

'I have recently come to the view that provided proper appreciation and financial support are forthcoming, it is the duty of people like us to stay in our own country and build up outstanding schools of research such as some other countries are fortunate enough to possess.'

Homi Bhabha to S. Chandrasekhar, 20 April 1944

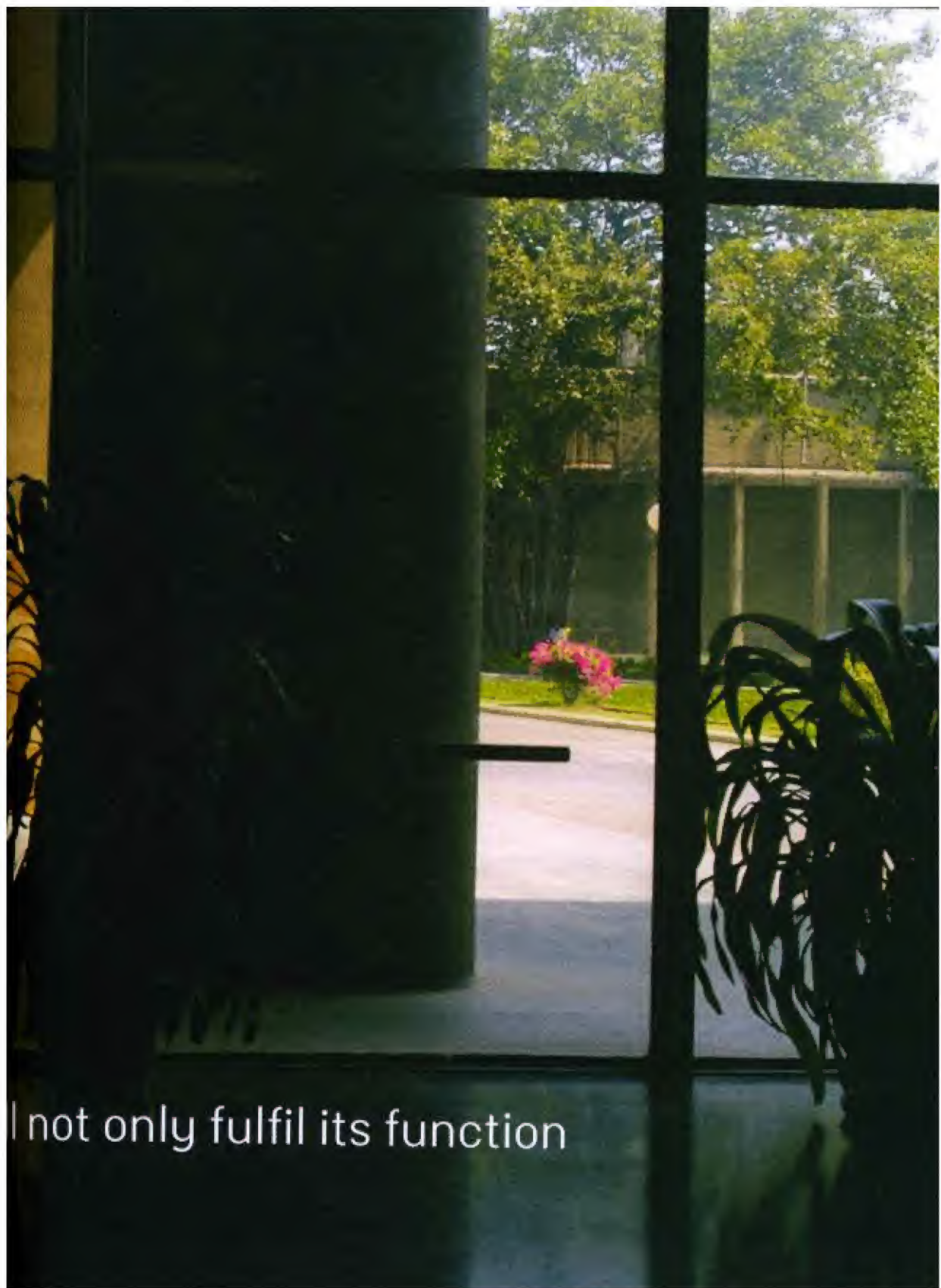


An Institute
is Born

1041

'The result, it is hoped, is a building which
but should afford a great deal of enjoyment

Helmuth Bartsch, Architect, TIFR, 1962.



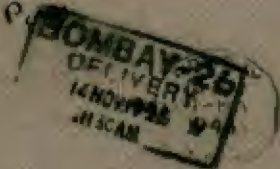
not only fulfil its function

On 12 March 1944, Bhabha wrote to Sir Sorab Saklatvala, chairman of the Sir Dorabji Tata Trust: 'It is absolutely in the interest of India to have a vigorous school of research in fundamental physics for such a school forms the spearhead of research not only in the less advanced branches of physics but also in problems of immediate practical applications to industry.'

Research and its links with industrial development was a theme that appealed to the trustees of the Sir Dorabji Tata Trust, among whom were Sir Ardeshir Dalal, John Matthai and J.R.D. Tata who became signatories to the Bombay Plan of 1945 that defined a possible route India could take to transform itself into an industrial nation. More importantly, Bhabha's proposal presented to the Sir Dorabji Tata Trust the opportunity to create through philanthropy a partnership between private enterprise, the government, and the university system.

The Tata Institute of Fundamental Research began functioning in the Cosmic Ray Unit of the Indian Institute of Science Bangalore in June 1945. By October that year it moved to Bombay and on 19 December it was inaugurated by Sir John Colville, Governor of Bombay. Here at the

Book - P



The Tata Institute of Fundamental Research functioned for some months at the Indian Institute of Science Bangalore. The Institute moved to Bombay and was formally inaugurated by Sir John Colville, Governor of Bombay on 19 December 1945.



Top Left: The Institute's first home at Kenilworth, Pedder Road, Bombay. Top Right: Homi Bhabha showing Sir John Colville the Counter Telescope. Bottom Left: Sir John Colville, Sir Sarab Saklatvala and Homi Bhabha. Bottom Right: Bhabha speaking at the inauguration in 1945.

Institute which he began in Kenilworth – premises he rented from his aunt Cooverbai Panday – Bhabha continued his work in cosmic ray physics. He gathered around him scientists and mathematicians who could help him grow science. The bonds he had forged with scientists in Europe were now enlisted to a new purpose – they visited his Institute, lecturing there and conducting courses.

An Institute
is Born

One of the first papers Bhabha wrote after the foundation of his Institute was on 'Relativistic Wave Equations for the Elementary Particles' in the *Reviews of Modern Physics* in a special edition published on the occasion of Niels Bohr's sixtieth birthday. He proposed in his paper to examine general first-order relativistic wave equations without any subsidiary conditions – the equations he proposed were subsequently named the Bhabha equations. Along with Chakraborty, he continued refining the calculations for cascade theory – studying the fluctuations in the number of shower particles in cosmic ray showers. He also continued High Altitude studies of cosmic rays – building on the experience gained at IISc. But he extended the work by making a beginning in nuclear emulsion technology.

19081

From the 1950s onwards, Bhabha's responsibilities increased as he became chairman of the Atomic Energy Commission. But he continued his work on meson scattering. In 1953 he wrote what would be his last paper on theoretical physics on multiple meson production. In this paper Bhabha used general considerations of relativistic kinematics to propose bounds on meson production rates in nucleon scattering. Despite the absence of a theory of strong interactions which eventually developed

WE 1 IN 1949 MOVED TO OLD YACHT CLUB 1 HIDEO YUKAWA AWARDED NOBEL PRIZE FOR PHYSICS 1950 1 INTERNATIONAL CONFERENCE ON ELEMENTARY PARTICLES HELD AT TRIER 1951 1 HOMI BHABHA NOMINATED FOR THE NOBEL PRIZE FOR PHYSICS 1 STUDY OF MUON INTERACTIONS AT POLAR BEAM MOUNTAIN

Prof. H.J. Bhabha,
Director,
Tata Institute of
Fundamental Research,
Apollo Pier Road,
Bombay - 1

The Institute moved to its second home at the Old Yacht Club in 1949 and remained there until the inauguration of the new buildings at Colaba in 1962.



Top: The sea face of the Old Yacht Club, the second home of the Institute.

Bottom: Niels Bohr, J.D. Choksey, Homi Bhabha and J.R.D. Tata seen at the Old Yacht Club, 1960.

1949 : TIFR MOVES TO OLD YACHT CLUB | 1950 : URQAWA AWARDED NOBEL PRIZE FOR PHYSICS | 1951 : INTERNATIONAL CONFERENCE ON ELEMENTARY PARTICLES HELD AT TIFR | 1955 : HOMI BHABHA NOMINATED FOR THE NOBEL PRIZE FOR PHYSICS | STUDY OF MOON INTERACTIONS AT KANAR GOLD MOUNTAIN

Prof. H.J. Bhabha,
Director,
Tata Institute of
Fundamental Research,
Apollo Pier Road,
Bombay - 1

The Institute moved to its second home at the Old Yacht Club in 1949 and remained there until the inauguration of the new buildings at Colaba in 1962.



Top: The sea face of the Old Yacht Club, the second home of the Institute.

Bottom: Niels Bohr, J.D. Chokshi, Homi Bhabha and J.R.D. Tata seen at the Old Yacht Club, 1960.

only in the 1970s, Bhabha elegantly predicted some qualitative properties of meson production cross sections.

After 1954 he no longer published scientific papers. But he ensured that the scientists at his Institute did not lack the facilities to carry out their research. His Institute grew. Within a few years the Institute moved to Old Yacht Club on Apollo Pier Road – not far from the imposing Gateway of India. In January 1962, Bhabha's Institute moved to its permanent home in Colaba. By then it had burgeoned into an establishment of unprecedented scope.

He had developed it with great thought, like a complex and elaborate experiment. He was convinced that the system of creating posts and then filling them was unsuited to India where 'science is still in its infancy and the number of available outstanding scientists limited'. Looking back at the process of institution-building, nearly twenty-one years after he established TIFR, Bhabha noted that it was a unique experiment – for unlike national laboratories in India that systematically filled up the scientific posts they advertised, his Institute had sought to recruit ability wherever it was found.

Speaking at the Birla Hall on 7 January 1966, Bhabha took great pride in this method of institution building. His speech, which was to be his last public speech, resonated with the energies of a successful nationalism. The vision that he had nurtured now stood on firm foundation.

Dr. H. J. Bhabha, F.R.S.,
2, Cunningham Road,
Bangalore.
RC :SK.

Bhabha's letter to Sir Sorab Saklatvala emphasized the need for an advanced institute of physics based in Bombay that would make the city a centre for fundamental research. Such a school would help young Indians gain technological confidence.

12.03.44 BHABHA TO SAKLATVALA

'The scheme I am submitting now is not one which has been hastily conceived. It has been germinating in my mind for nearly two years, and I recently discussed it at length with Prof. A.V. Hill both at Delhi and Bombay. Prof. A.V. Hill, Senior Secretary of the Royal Society, apart from being an eminent scientist himself, is one who has a great and intimate knowledge of the organization of science and scientific institutions in England, and the many valuable suggestions he made have been incorporated in the scheme as it stands.

There is at the moment in India no big school of research in the fundamental problems of physics, both theoretical and experimental. There are however scattered all over India competent workers who are not doing as good work as they would do if brought together in one place under proper direction. It is absolutely in the interest of India to have a vigorous school of research in fundamental physics, for such a school forms the spearhead of research not only in less advanced branches of physics but also in problems of immediate practical application in industry. Moreover, when nuclear energy has been successfully applied for power production in say a couple of decades from now, India will not have to look abroad for its experts but will find them ready at hand. I do not think that anyone acquainted with scientific development in other countries would deny the need in India for such a school as I propose.

Prof. Hill, when he was in Bombay, repeatedly stressed the fact that all research has in the beginning to be built round a suitable man, and at the present moment there is no one else in India able to do the type of research proposed.

It might at first be supposed that the absence of a good school of physical research in Bombay at the moment would make it an unsuitable place for the object I have in mind. This is not so. The best and the most promising students desirous of studying theoretical physics or cosmic rays, who for the last three years have been sent to me in Bangalore from all parts of India, would come to Bombay instead. I am convinced that within five years we could make Bombay the centre of fundamental physical research in India.

It was while I was on holiday in 1939 that the war broke out and stopped my return to my job in Cambridge. For some time after that, I had the idea that after the war I would accept a job in a good university in Europe or America, because universities like Cambridge and Princeton provide an atmosphere which no place in India provides at the moment. But in the last two years I have come more and more to the view that provided proper appreciation and financial support are forthcoming it is one's duty to stay in one's own country and build up schools comparable with those that other countries are fortunate in possessing.

The scheme I am now submitting to you is but an embryo from which I hope to build up in the course of time a school of physics comparable with the best anywhere. If Tatas would decide to sponsor an institute such as I propose through their Trust I am sure that they would be taking the initiative in a move which will be supported soon from many directions and be of lasting benefit to India.'

An excerpt from Bhabha's letter to Sir Sorab Saklatvala, 12 March 1944.

Subrahmanyan Chandrasekhar (1910-1995), FRS, astrophysicist, won the Nobel Prize for physics (1983) with William Alfred Fowler for theoretical work in the structure and evolution of stars. Chandrasekhar's time in Cambridge overlapped with Bhabha's time there and they were both students of R.H. Fowler.

20.04.44 BHABHA TO CHANDRASEKHAR

Dear Chandrasekhar,

I was very pleased to hear your well deserved election to the Fellowship of the Royal Society. Please accept my warm congratulations.

The trustees of the Tata Trusts have decided to sponsor a scheme I put forward for an Institute for advanced research in physics, both theoretical and experimental, to be located in Bombay. We hope to make it a centre of advanced research, especially of theoretical research in physics and mathematics in India. Your own line of research would certainly come within the scope of the scheme and if it were possible to create a Chair for you would you be prepared to consider it? The Professors grade will be the same as that in the Indian Institute of Science, Bangalore, namely Rs. 1000-Rs. 1250, though of course in special cases the starting salary may be anything above Rs. 1000. The duties of the Professor will be to carry on and direct research, to take part in colloquia and give say one course of lectures per term on some advanced subject in his own line. The leave and vacation rules will be more or less the same as in the Bombay University, enabling you to take 4 to 5 months vacation a year which you may use for visiting foreign countries like USA and maintain contact there. I think you will hardly get more favourable conditions for carrying on your research anywhere and especially in India, for example, as you are aware, a Professor in an Indian University even under the most favourable and special conditions is over-laden with routine work and in the Government Research Institutions one would be the victim of the usual red tape with little understanding of the needs of scientific men.

I myself have up to recently felt that after the war I would accept some good job in some University in Europe or America, because a place like Cambridge has an atmosphere which no place in India has at the moment. But I have recently come to the view that provided proper appreciation and financial support are forthcoming, it is the duty of people like us to stay in our own country and build up outstanding schools of research such as some other countries are fortunate enough to possess. It is for this reason that I put forward my scheme and I am very glad to say that it has met with understanding and liberal support. It is our intention to bring together as many outstanding scientists as possible in allied lines so as to build up in time an intellectual atmosphere approaching what we knew in places like Cambridge and Paris. I am sure that if we do our work successfully, financial support on a liberal scale will not be lacking.

I should make it clear that this is only an informal approach on my own initiative; but if I hear from you that a Chair along the lines I outlined above would be accepted by you, then I shall see what I can do to get such a chair created.

With best wishes,

Yours sincerely,

Homi J. Bhabha

Chandrasekhar was among the first physicists that Bhabha invited to join his Institute. Chandrasekhar considered the idea for a while though he never returned.

02.04.46 CHANDRASEKHAR TO BHABHA

The University of Chicago

Perkes Observatory
WILLIAMS BAY, WIS.

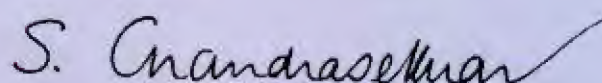
Dear Bhabha,

I am sorry to be so long in replying to your letter of last year. But, since I wrote to you last, some difficulties regarding emigration have arisen and I have been waiting, hoping that I may be able to write definitely. However, the situation is still very confused. The position is this: As I wrote to you, it was my intention to take a year's leave of absence from the University of Chicago and join your institute in the first instance on a temporary basis. On inquiry, I find that at the present time the State Department does not grant re-entry permits to permanent residents in the non-quota category. And if I cannot get a re-entry permit, then I must again seek a new visa of the same kind as I now have, and here I have been warned that the conditions of issuance of such visas is very stringent now and is likely to increase in stringency in the future. In other words, without a clarification from the State Department of the present confused situation regarding re-entry permits, it would not be possible for me to plan leaving this country. In addition to this major problem, the University of Chicago is reluctant to grant me such a lengthy leave of absence at the present time and they advise me to wait for a little while. And finally, it now looks as though the various things I had intended to finish this year would not be completed. Thus, all things considered, it looks very much as though that it would not be possible for me to leave this country by the end of this year as I had originally planned. However, it is not impossible that things might clear up by the time you visit this country when I hope we can discuss the matter.

I am sorry to leave the matter in this unsettled state, but I hope you understand my position.

With kindest regards,

Yours very sincerely,



S. Chandrasekhar

Damodar Dharmanand Kosambi (1907-1966), mathematician, statistician, historian, well-known for his work in numismatics, was one of the first mathematicians to be invited by Bhabha to join TIFR. In the early years, Kosambi was very involved with the Institute – taking charge of it in Bhabha's absence.

21.11.46 KOSAMBI TO BHABHA

53 Pedder Road,

21 - 22nd November, 1946.

Dear Bhabha,

We all hope that you will not delay beyond the middle of December in reaching India and that you will come here ready to plunge into a considerable amount of administrative work. The main item pending your arrival is a Council meeting to decide next year's budget. In addition there is the question of a permanent constitution and title to the Colaba site. We had a visit there with Sir Sorab Choksi, Surveyor (Port Trust Engineer), Bhansali (Chief Secretary, Educational Department) and last but not least Morarji Desai, the Congress Home and Revenue Minister. Morarji is an extremely tough nut for anyone to crack, though a man of his word and absolutely straight. The situation is that both he and the Port Trust are willing to let us have our land, but that neither party is willing to let the other have any title to the land itself. Choksi suggested that matters could be speeded up considerably if both parties agreed to let us start our building operations without prejudice to each other's claims. But as Morarji rightly pointed out in this case the words 'without prejudice' would have no meaning whatsoever the moment the Government of Bombay gave any sanction, while he was definitely not willing to admit that the Port Trust could make any such grant in its own right. Between ourselves the Port Trust title in this particular case seems to be extremely weak while there is a further catch in the situation to the effect that the Government of Bombay will ask us for not less than Rs 10/- a sq. yd. The only cure is to ask them for a greater amount from the Educational Department (Morarji never gives a penny to anyone) and Choksi suggested that this could be done very easily by the Sir D.J. Tata Trust first raising its own capital grant. This is all very nice as far as it goes but you see that we cannot undertake building operation this season without a proper and secure title. The principal difficulty with the Government of Bombay is its leaden foot, which is further shackled by strong chains of red tape. To dictate a letter which you or I could get out of the way within seven minutes it takes two or three interviews at the Secretariat and even then all we get is that the matter will be attended to in due course.

Yesterday I had to face a barrage of rather penetrating and decidedly intelligent questions about the Institute from J.R.D. Tata at the Sir D.J. Tata Trust meeting. It was quite an unexpected summons and I hope I did not do too badly. The position is that we still have a faint chance of getting Chern and the Chinese delegation but here again is some red tape from the Central Government. I still think that Jawaharlal will come through with a personal note to Chiang Kai-Shek. Incidentally if you know of anyone at UNESCO who can help in this matter do try to drop a line in the proper place. The argument is that Chern has been asked by the Academia Sinica to build their mathematical institute which would, presumably, secure the UNESCO grant and calculating machines for China while we would be doing the same things for India. Naturally the two ought to work in close cooperation. This argument may sound a bit thin unless you pad it out with your own ingenious devices.

An Institute
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11141

This letter reveals his frustrations with bureaucracy not only in procuring land for the permanent building but also with trying to invite the Chinese mathematician S.S. Chern. Kosambi the polymath, talks about the Sanskrit book he had completed as well as his book on path geometry. We also reproduce below a comic strip with a comment scribbled by Kosambi - which he had sent Bhabha. Bhabha and Kosambi developed irreconcilable differences later.

Bombay has not yet recovered from three months of rioting and looting of shops. I saw a considerable amount of both having to go in one badly affected area at least twice every week. The result has been that we still have no definite accomplishment to show, though Thatte's cosmic ray counters are still on the verge of completion.

My own work shows some results. I have got one more Sanskrit book off my chest, and the last (or so I hope) has finally been taken up by the printers. The book on Path-Geometry will, according to a letter from Morse, appear in the *Annals of Mathematics Studies* at Princeton. This means a planograph edition, not ordinary printing; however I am in quite distinguished company for Hermann Weyl has two books in that series and Morse himself has one. I have still heard nothing whatsoever from Mott who should have received my manuscript a long time ago. I can only suggest that if you go to England at any time before you return you might recover the manuscript with proper attention to the delicacy of the extractions, unless there is someone in England really interested in reading it. You will realize that I myself have no copy at all of the work, never having been able to recover the second carbon which was presumably left in your bedroom at 'Mehrangir'.

Could you say a definite word about the possibility of getting Chandrasekhar (or someone else) because we have to make up our cadres reasonably soon. I myself have no research student at all, which suits me very well because I have been able to grind out a considerable amount of almost purely mechanical work, most of which is only 'experimental mathematics' unfit for publication though some of which will lead to certain results in future. This of course is in addition to signing all kinds of notices, letters and applications which should normally have fallen to your lot.

The UNESCO machine was described under the title of ENIAC by Hartree in Nature. I do not see that we need any more room or staff than originally set forth in my first letter on the subject; we may be able to cut down on the draughtsmen and mechanics if we have only the electronic analyzer. By the way if you meet anyone from the USSR at Paris be sure to establish the necessary good relations.

Yours sincerely,

D.D. Kosambi



Cecil Frank Powell (1903-1969), FRS, was a physicist who won the Nobel Prize in physics in 1950 for developing photographic methods for studying nuclear processes that resulted in the discovery of the pi-meson. In 1948, Powell promised Bhabha that one of the microscopes that he had already ordered could be released to TIFR.

25.10.48 BHABHA TO POWELL

WILL PHYSICAL LABORATORY

Dear Powell,

Early this year, you very kindly offered to release for the Tata Institute of Fundamental Research one of the microscopes from a batch ordered by you. The firm, Cooke Trouton etc., informed me then that this microscope would be delivered in August this year. Would you be so kind as to find out whether this microscope has been sent out to the Tata Institute and if not when it will be sent?

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I understand that they have sent out to India a microscope which had been ordered by Sarabhai and I am only anxious that no confusion should take place. It was just because priorities for delivery before the middle of next year could not be obtained that I accepted your offer to release one of the microscopes ordered by you and I am, therefore, surprised that they should have been able to deliver one to Sarabhai this year. I am very glad about this but I only wish to make sure that it is not the microscope released by you which has been sent out to Sarabhai by mistake.

Will you please send your reply c/o Messrs. Tata Limited, 18 Grosvenor Place, London, who will forward it to me?

With kind regards.

Yours sincerely,

Homi Bhabha

P.M.S. Blackett, Baron Blackett (1897-1974), FRS, experimental cosmic ray physicist, won the Nobel Prize for physics in 1948. Bhabha had met Blackett when he was a student at Cambridge. Bhabha recommended Blackett as Military Advisor to the Government of India. It was at Blackett's initiative that the Geophysics Research Group at TIFR took up Paleomagnetic studies in 1955. Work in the area of paleomagnetism had its origins in the realization that studies of Indian rocks could be particularly valuable for testing the controversial hypothesis about continental drift.

27.07.54 BLACKETT TO BHABHA

IMPERIAL COLLEGE OF SCIENCE AND TECHNOLOGY
(UNIVERSITY OF LONDON)

Dear Homi,

I am planning an investigation of the magnetism of certain Indian rocks in order to test a hypothesis of Continental Drift. We would like to send a couple of men, probably one physicist and one geologist, to India in autumn or early next spring to start collecting and measuring the rocks. We would like to know whether it would be possible for them to base themselves on your Institute. We would suggest sending out with them some rock cutting tools and a magnetometer. If a space could be found to erect the magnetometer in or near your laboratory, they could use this as headquarters, at any rate while studying the rocks of Eastern India.

We would like to coopt all the help we can from Indian geologists and I am writing to Dr Krishnan of Calcutta about my plans. We rather hope that some Indian groups would take up energetically this fascinating new subject of rock magnetism, and if any group does want to do this we would give them every possible help. However, we feel that it would take too long to wait for this to happen spontaneously so we would like to start off the work ourselves.

Ought we to ask someone for official permission to collect rocks in India and if so, whom?

I am sending under separate cover a copy of Clegg's paper on the magnetism of British rocks. Incidentally, much of the best account I know of Continental Drift theories is to be found in Holmes' *Principles of Physical Geology*. One can see from this account the key position that India has in such theories. You will remember that by magnetic methods we might hope to find the magnetic latitude of a country in ancient geological times, but not, of course, the longitude. Since, on these various Drift theories, India has made the major movement from south to north, it is especially well fitted for study.

How are things going? We much enjoyed seeing Peters here. When are you next coming to Europe.

Yours,

Patrick Blackett

Bhabha's sketch of Blackett, 1953



John von Neumann (1903-1957), mathematician, made major contributions to numerous fields including set theory, quantum mechanics, ergodic theory, economics, game theory and computer science.

03 02 48 VON NEUMANN TO BHABHA

**THE INSTITUTE FOR ADVANCED STUDY
SCHOOL OF MATHEMATICS
PRINCETON, NEW JERSEY**

Dear Bhabha,

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Please excuse my delay in answering your letter. In consequence of various climatic adversities (I don't know whether you were still in New York to observe them – but there was a sequence of quite unusual blizzards which paralyzed airplane and even railroad communications too), and in consequence of the fact that I was moving around several places in the West between January 16th and 26th, your letter reached me only after several delays, and I can answer it only now after my return to Princeton. I hope that your trip to the United States and the subsequent trip to Europe have been pleasant and fruitful, and that this letter, which it seems I had best send to your New York address, will reach you without any great delay.

I am much obliged to you for your intention of sending me the equation of the meson in a coulomb field. I am looking forward to this.

11181

I am in essential agreement with your remarks about the 'philosophy' of using in the future high-speed calculating machines. They will at first necessarily be rather rare and, therefore, the ones which exist should be used on as broad and as varied a basis as possible. From every possible point of view, it would be a great mistake to tie them down to any one particular problem and to any kind of routine production. The theory and practice of solving non-linear partial differential equations, in hydrodynamics as well as in other fields; the execution of large statistical experiments, especially in the kinetic theory of matter; some parts of astro-physics and the theory of stellar systems, as well as in a number of problems connected with cosmic ray showers; calculation of atomic and nuclear energy levels and wave functions, both in 'quantum chemistry' and nuclear theory; analysis of theories of statistical significance; various problems related to but going considerably beyond Fourier analysis in connection with crystal and molecular structure determinations in X-ray crystallography – these are the main problems which now come to my mind, but I am sure that the list will prove to be incomplete once the machines are actually available and we will be able to do things instead of planning for them. I think that it would be very desirable to have the machine run under a system of organization which makes it accessible to many scientific groups and guarantees a wide and varied use.

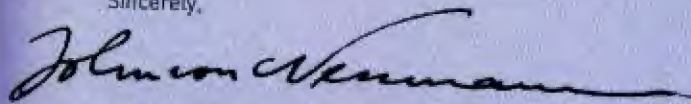
The term 'von Neumann architecture' arose from his paper, 'First draft of a report on the EDVAC' dated 30 June 1945. Bhabha discussed this report with R. Narasimhan who went on to build the first general purpose computer in India at TIFR, the TIFRAC, in 1959.

If you think that it is of any use from the point of view of the use of such a machine in India, I will be very glad to write you in more detail about this subject and outline somewhat more specifically at least some of the things which might be done in the fields mentioned above.

I wouldn't like to conclude this letter without telling you what a great pleasure it was seeing you again, and I am, too, strongly hoping that we will get together again in the not far future.

With best wishes,

Sincerely,

A handwritten signature in black ink, reading "John von Neumann". The signature is fluid and cursive, with a long horizontal stroke at the end.

[John Von Neumann]

Dr. Homi J. Bhabha
Tata Incorporated
90 Broad Street
New York 4, New York

Max Born [1882-1970], was a physicist who made seminal contributions to quantum mechanics. He won the Nobel Prize in physics in 1954. Exiled from Germany during the Nazi regime, he arrived in Cambridge in 1933. Born spent 1935-1936 at the Indian Institute of Science, Bangalore. He left for Edinburgh when Sir C.V. Raman's efforts to procure a permanent position for him were thwarted. In 1947, Bhabha invited Born to spend a couple of years at his Institute, Born was unable to come. Born's letter refers to his nephew, Otto Königsberger who was chief architect at Mysore and responsible for the buildings at the Indian Institute of Science, Bangalore. Bhabha was close friends with Max and Hedwig Born and their son, Gustav. He was also closely acquainted with Otto Königsberger.

29 10 47 BORN TO BHABHA

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My dear Bhabha,

Your letter of the 21st October was a great pleasure both to my wife and to myself.

However, the information which you got from my nephew Otto, about my retiring soon from Edinburgh University was quite wrong. In fact I have had an offer of a Chair at the Dublin Institute for Advanced Studies, and Schrödinger was very keen that I should go there. It would have had the advantage that I could have continued in office until my 75th year, by annual re-appointment, but on the other hand, there was no provision made in case I should be obliged to retire earlier for health reasons, while here, in such circumstances, I shall have a tiny pension. Therefore, after long deliberation, I have decided to remain in Edinburgh, where I can continue until I am 70 years of age, which means another five years.

I am very much touched by your offer that I should come to your Institute in Bombay to teach there for the next five years, but I am afraid I cannot accept this offer, as I have now settled down in Edinburgh for that period. On the termination of my office here, I am wondering if I should not be too old to come, as people over 70 are generally regarded as of no great use. However, I shall keep this in mind, for both my wife and I love India, and would be very happy to see it again.

I think it would be possible for me in a year or so, to get leave of absence, say for one or two terms and to come to your Institute as a visiting Professor. I have, for instance, taken such leave for next term, which I shall spend in Oxford, giving the Waynflete Lectures there. I could not, of course, ask at once for another such extended leave, but perhaps in a year or two this would be possible, if you really think you would like to have me in Bombay.

We are working mainly on the kinetic theory of dense matter, but have also plans for fundamental research in other directions concerning elementary particles. One of my pupils, Dr H.S. Green has a new form of the theory of particles with higher spin, which seems to me to be simpler than any I have seen in literature, including your own work. I think you will be interested in these things.

My wife and I would be very pleased to see you here during your visit to Europe, but as I already said, I shall be away from Edinburgh, staying at Magdalen College, Oxford, from about the 12th January until the end of the term. Before this, I shall probably be in Brussels from the 5th till the 8th January, attending a meeting on Thermo-Dynamics.

I am looking forward to seeing you in Oxford, but my wife would be very sorry if she missed you. She is particularly keen to revisit India, where she made many good friends.

With kind regards,

Yours sincerely,

Max Born

11201

J. Robert Oppenheimer (1904-1967), physicist, is best remembered for his role as scientific director of the Manhattan project. An eminent theoretical physicist, Oppenheimer had done his PhD with Max Born at the University of Göttingen. From 1947 to 1966, Oppenheimer was Director of Princeton's Institute for Advanced Study where Bhabha had met him several times. Bhabha's letter to Oppenheimer refers to the scientific work being carried out at his Institute, particularly by Bernard Peters who had done his PhD with Oppenheimer.

19.08.52 BHABHA TO OPPENHEIMER

Dear Robert,

This is just a line to tell you that I expect to be in Princeton sometime between the 3rd and the 10th of September and look forward to seeing you both again.

I have just completed some work on high energy nuclear events which shows the relation between nucleon produced and meson produced showers. The work of Peters and his group here has established that these are of two different types contrary to what might be expected on the Fermi Theory. I have been able to show the theoretical relationship between these two types of showers by a refinement of the Fermi Theory.

With kind regards,

Yours sincerely

Homi Bhabha

In 1944, A.V. Hill had advised Bhabha to include biophysics within his Institute. However, biology at the Institute did not begin until 1962 when Bhabha invited Dr Obaid Siddiqi to begin molecular biology at the Institute. Siddiqi's letters of recommendation from Guido Pontecorvo and Alan Garen were sent to Bhabha by the physicist Leó Szilárd. Bhabha not only wrote to Nehru about Siddiqi's appointment, he also quoted from Pontecorvo's letter to make a more general point about the problems Indian science administration had inherited from the colonial past.

02 08 62 HOMI TO NEHRU

My dear Bhai,

Earlier this year a well-known scientist, Dr Leo Szilard brought to my attention a young Indian molecular biologist of outstanding ability, Dr Obaid Siddiqi, who wanted to return to India, though he has many offers of appointment abroad. We have offered him an appointment which he has accepted, and he will be joining us this month. His case was strongly supported by a number of internationally known biologists including Professor G. Pontecorvo of the Department of Genetics of the University of Glasgow. In the course of Professor Pontecorvo's letter to Dr Szilard the following sentence occurs:

'I think that it would be very important for the progress of biology in India that he should go back to a job in which his ability would be fully expressed: in fact, I am really baffled as to why India seems to promote easily mediocre scientist-politicians and does nothing to retain their really good scientists.'

I thought that I should bring this last sentence to your notice because it gives one an indication of the impression that prevails abroad about Indian science and the Government's attitude to it, despite the considerable progress that we have made. I am afraid the impression is not entirely ill-founded, and we have not got away from our inheritance of pre-independence days in which whoever spent his time on administration was considered to hold a more important position than someone who was doing work in a laboratory, although the latter might be of greater significance from a world point of view.

Yours affectionately,

Homi

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Joseph Lade Pawsey (1908-1962), FRS, engineer, radiophysicist, radio astronomer, did his PhD at Cambridge where his time overlapped with Bhabha's. Pawsey was a research physicist at CSIRO Division of Radiophysics in Sydney where Govind Swarup worked with him (1953-1955). Swarup joined TIFR in 1963 and went on to build the radio astronomy group.

06.10.61 PAWSEY TO BHABHA

LIASON OFFICE | AFRICA HOUSE | KINGSWAY | LONDON WC2 | HOLBORN 3422

Dear Professor Bhabha,

I have received a letter from T.K. Menon enclosing a proposal which he in collaboration with T. Krishnan, M.R. Kundu and G. Swarup, has prepared on the subject of the possibility of the promotion of a new radio astronomy group in India. Menon suggested it might be helpful if I wrote to you with my comments on their proposal. I am very happy to do this because I should like to help where I can in the stimulation of science in India.

It so happens that I know personally most of the young Indians mentioned in the proposal. Two of those who prepared the proposal, Krishnan and Swarup, have actually worked under my direction in the CSIRO Radiophysics Laboratory, Sydney, so that I am in a good position to assess their competence. I have a very high opinion of the scientific talent of this group and I feel sure that given satisfactory working conditions, a group chosen from among them should have an excellent chance of building up a first class scientific institution. For example, I would rate their combined talent as not worse than any current American group. The programme of research they suggest appears very sensible to me, but the details should obviously be reconsidered in the light of future developments at the time of commencement.

There has been considerable discussion among the Indian radio astronomers as to the best form of organization, e.g. University, Government Research Institute or private research institute. The stimulation of science in a developing country such as India or Australia depends on many factors relating both to the provision of facilities and to the inspiration of individuals. I expect to see it develop in diverse ways and feel that one of the most important tasks of administration is to encourage these activities which show promise. I regard this spontaneous movement among the young Indians who have initiated this proposal as a most encouraging sign and strongly urge you, in the interests of science in India, to try and assist them in their efforts to work out something worth while.

I am writing similarly to Professor D.S. Kothari and Professor M.S. Thacker.

Yours sincerely,

J.L. Pawsey

When Soviet Premier, Nikolai Bulganin and Party Secretary, Nikita Khrushchev visited India in 1955, they also visited TIFR. During their visit, Bernard Peters spoke on heavy primaries in cosmic radiation.

In this photograph, Khrushchev looks at tracks under the microscope, while Bulganin waits. Peters is seen behind Bhabha.



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'Responsible people here like Dirac and Blackett, neither of whom have any connections with the Communists, feel that in the interest of good relations such invitations should be accepted if they fit in with one's plans. I would in any case like some time to see for myself what things are like in the Soviet Union, but it will have to be on some future occasion.

As a high level academic institution there must be as much intellectual freedom in the TIFR as there is in any British University and unless this freedom is ensured you will not get men of calibre that there should be in the Institute.'

Homi Bhabha to Rustum Choksi, letter from London, 10 May 1951.

Bernard Peters (1910-1993), cosmic ray physicist, was invited by Bhabha to join TIFR as Professor of Experimental Physics in 1952. He conducted research in cosmic ray physics, guiding the group to several breakthroughs in the area. Peters had done his PhD with Robert Oppenheimer at the University of California, Berkeley after escaping from Nazi Germany as a fugitive. He had gone on to work on the Manhattan Project. Peters became a victim of the witch hunts during the McCarthy era. He arrived at TIFR on Bhabha's invitation soon afterwards and spent seven years there. He remained in touch with the Institute even after he left for Copenhagen in 1959. He went on to become Director of the Danish Space Research Institute. He was awarded the Padma Bhushan in 1985.

Perhaps the most important contribution which Homi Bhabha has made to cosmic ray physics lies in his anticipation, several years before it became apparent to every one, that this branch of physics was destined to revolutionize earlier concepts of the nature of matter and therefore was going to play a very central role in natural sciences, as, indeed, it did in the late forties and early fifties. He realized that here was a line of research where with relatively modest financial means, one could penetrate right to the front line of contemporary science. He reasoned then that cosmic ray research was ideally suited to achieve his aims, namely: to develop in India important techniques of modern experimental physics, to contribute significantly to contemporary science and last but not the least, to instill in young Indian scientists the confidence that in spite of innumerable obstacles such as financial stringency, lack of technical experience and lack of traditions in experimental sciences, they could by means of hard work and devotion and by means of their own ingenuity achieve scientific results of the very first order, in no way inferior to those obtained elsewhere.

Bhabha always encouraged development of original techniques. The Tata Institute group was first to construct out of unbacked sheets of nuclear emulsions large volume detectors which could be used with the same precision as the relatively thin emulsion plates employed earlier in high energy work. This technique which greatly enhanced the value of nuclear emulsions as particle detectors is now universally employed. It permitted the group to make among other things the first observations on the interaction of negative kaons with matter, on nuclear scattering and also some unusual decay modes of positive kaons, and resulted in one of the first precise determination of the mass of the λ -hyperon etc. Important contributions to the difficult problem of determining the energy of particles by measuring their scattering [i.e., the extremely small deviations from a straight line which characterize their tracks] also had their origin in this technique of constructing emulsion block detectors.

With the years the equipment which had to be sent into the stratosphere grew in size and complexity; the bunches of rubber balloons used earlier became insufficient to carry the loads. New giant balloons made out of very thin plastic foils had been invented in the USA but could not be bought and the manufacturing technique was protected by military secrecy. Bhabha gave full support to a project of producing appropriate plastic foils in Indian industry and reinventing the American techniques of constructing balloons thereby overcoming these obstacles to stratosphere research. This difficult technical feat was successfully accomplished and India became the second country able to construct plastic stratosphere balloons for large payloads. Again this technical success led to important scientific results as, for instance, the details of the charge composition of primary cosmic rays at high energy and the first determination of the ratio of positrons to electrons among the primary galactic particles of very high energy (> 15 GeV), a quality which is of great astrophysical importance.

The First International Conference on Elementary Particles

TIFR, Old Yacht Club, 1950

Bhabha organized an International Conference on Elementary Particles at TIFR from 14 to 22 December 1950. Those present included Patrick Blackett, Bernard Peters, Legist Rosenfeld, Gregor Wentzel, Leprince Ringuet, Edoardo Amaldi, M.N. Saha, K.S. Krishnan, Vikram Sarabhai, D.S. Kothari and R.C. Mazumdar to name but a few. *Current Science* in its January 1951 issue noted 'This was the first time that a conference of this type on such a high scientific scale has been held in India.'

The following verses were read at a social function after the conclusion of the Conference. The poem written by Peierls and Rosenfeld also includes a reference to the fastidious and formidable Mrs Vesugar who was a secretary at Bombay House and occasionally helped Bhabha at the Institute.

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*The meetings laid the greatest stress on
What can be said about the meson.*

*Things would not work if Doctor Bhabha
Was not tough as steel but resilient as rubber,
Here 'chini' is the word for 'sugar',
The word for 'frankness' is 'Vesugar'.*

*This time, as many times before,
The first to speak was to be Bohr,
But Bohr, though he was chosen, failed
To come, so we had Rosenfeld.*

*For this, of course, one had to summon
Such famous men as C.V. Raman,
Pick any delegate you wish, none
Could smile more cheerfully than Krishnan.*

*From Bristol we expected Powell, or
His chief collaborator Fowler,
We sadly missed Professor Möller,
I think he ate too much – poor fellow.*

*At night the sky is starry
With white dwarfs for Kothari,
No nut in cosmic rays that Blackett
Would find so hard he could not crack it.*

*I doubt if in the work of Wentzel
All singularities will cancel,
We listened raptly to the razor-
Sharp logic of J. Eliezer.*

*Much praise deserves Leprince-Ringuet,
His French is so dear, his shirt so gay,
From France came also Professor Fleury,
He got here late so he was in a hurry.*

*It seemed in the end very doubtful whether
We have yet found the anti-di-Feather,
Balloons dispatched by Doctor Peters
Will float at 30,000 metres.*

*At Poona Commissioner Perrin
Admired the atom station's terrain,
To hold the formulae of Peierls
The blackboard must extend for miles.*

*We all have heard the saga
Of the labs built by Bhatnagar,
The counters of Milvaganam
Don't seem to have a bug in 'em.*

*The curve of Doctor Rao
Goes down we don't know how,
Nobody here at all dis-
Approves of the Amaldis.*

*Statistics is made thorough by
The work of Doctor Sarabhai,
No cosmic ray so far has
Proved the theory of Saha's.*

*We leave but Doctor Seligman,
The lucky guy can still stay on.*

Written by R.E. PEIERLS and L. ROSENFELD

FEYNMAN AND MURRAY GELL-MANN PROPOSE A LAW OF WEAK INTERACTIONS IN STRANGE-PARTICLE DECAY AND IN BETA DECAY

STUDIES IN MOSSBAUER SPECTROSCOPY INITIATED AT TIFR



Taken during the conference at the Old Yacht Club this group photograph shows among others, Vikram Sarabhai, Bibha Chaudhuri, Rudolf Peierls, Patrick Blackett and M.N. Saha.



International Colloquium on Function Theory

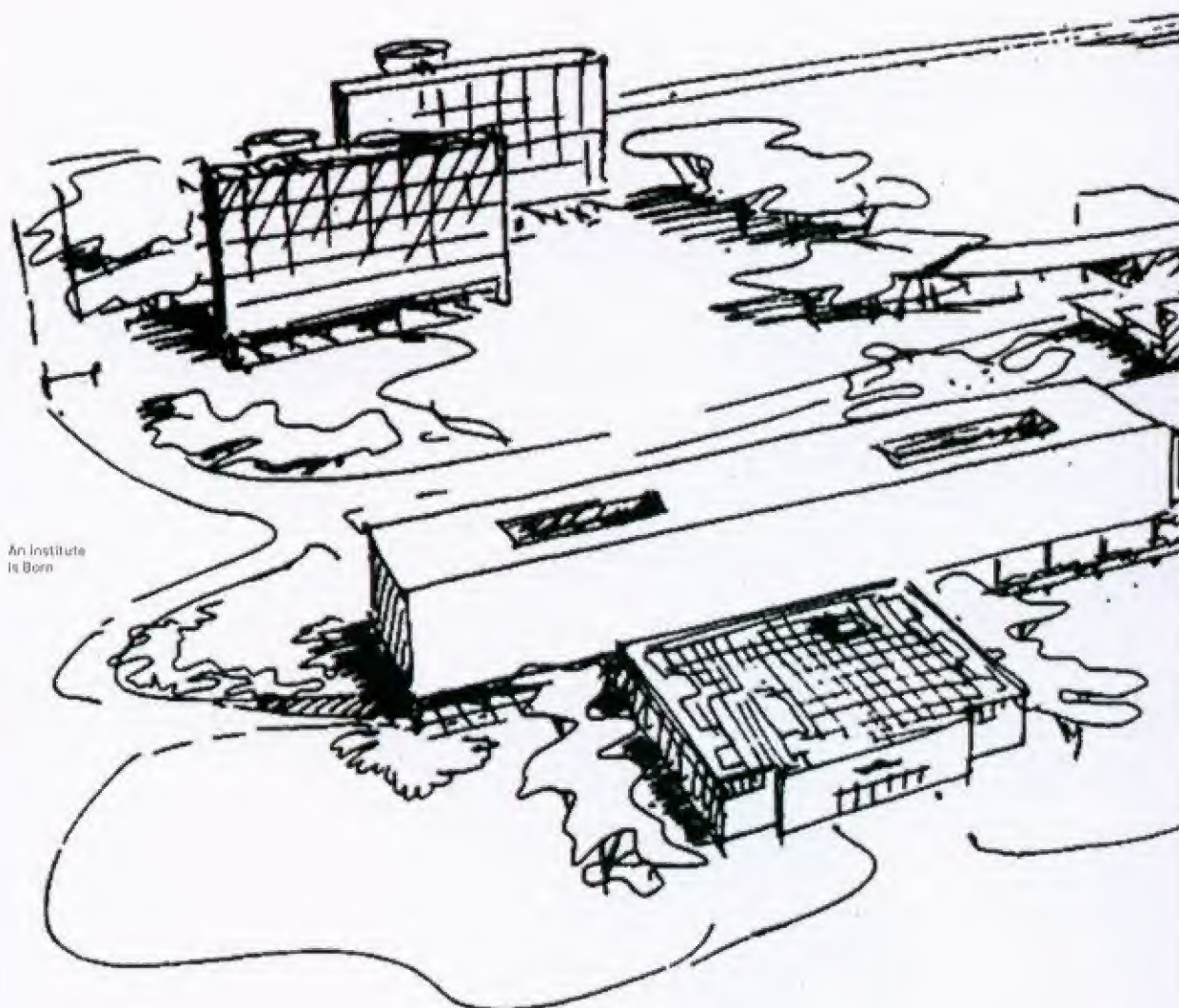
Tea party, TIFR, Old Yacht Club, 1960.

The mathematician K. Chandrasekharan joined TIFR in 1949 on Bhabha's invitation and was responsible for making the School of Mathematics among one of the most respected Institutions in the world. An extraordinarily gifted organizer, Chandrasekharan had urged Bhabha to review and examine the unpublished notebooks of the great mathematical genius Srinivasa Ramanujan that were languishing in Madras University. A committee comprising the mathematicians Hans Rademacher, Hans Maass, K.G. Ramanathan and Chandrasekharan examined the Notebooks. With permission from Sir A. Lakshmanaswami Mudaliar, Vice Chancellor of the University of Madras and a publication grant from the Sir Dorabji Tata Trust, the *Notebooks of Srinivasa Ramanujan* was published in two volumes in 1957. In 1960, a special leatherbound set of the Notebooks was presented to the Royal Society of London by Bhabha.



K. Chandrasekharan showing the facsimile edition of the *Notebooks of Srinivasa Ramanujan* to Pandit Jawaharlal Nehru while Dr Bhabha looks on. 15 January 1962

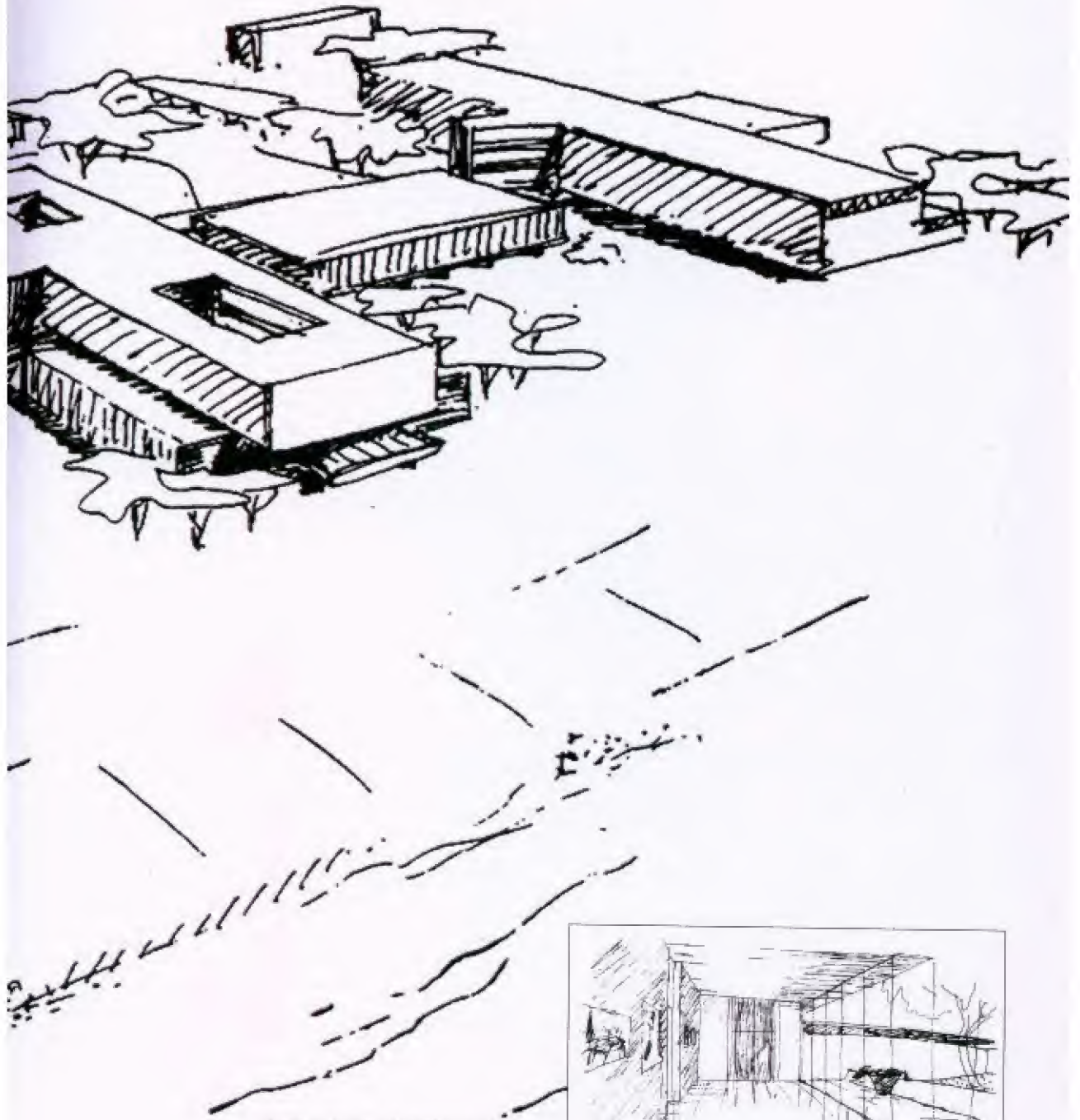
Facing page: The International Colloquium on Function Theory was held at TIFR in 1960 on the initiative of K. Chandrasekharan. The Colloquium included mathematicians such as Henri Cartan, Carl L. Siegel, Hans Grauert among others.



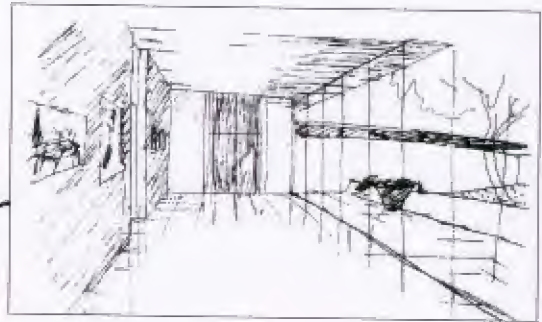
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Is Born

11301

Homi Bhabha invited Helmuth Bartsch to design the new buildings for TIFR after the land in the Naval area in Colaba was acquired with Nehru's help. Bartsch was one of the partners of Holabird and Root of Chicago. The TIFR building also shows a considerable influence of the last director of Bauhaus, Ludwig Mies Van der Rohe, whose design had had an impact on Bartsch. As Bartsch wrote in 1962, 'The client displayed unending interest and encouragement and constantly added intelligent suggestions and advice. The result, it is hoped, is a building which will not only fulfil its function but should afford a great deal of enjoyment.'



Concept sketches for TIFR's new buildings
by Helmuth Bartsch, late 1950s



Sir Shanti Swarup Bhatnagar (1894-1955) became a member of the Council of TIFR in 1947. But even before India became independent, Sir Shanti as Director General of the CSIR and Secretary to the Ministry of Natural Resources and Scientific Research played an active role in helping Homi Bhabha build the Institute. It was with Bhatnagar and Nehru that Bhabha discussed the acquisition of the Colaba plot - the site where the Institute is presently located. Bhatnagar did not live to see the the new building completed. He died on 1 January 1955.

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1952



'In a meeting of the Atomic Energy Commission I was pressing for more speed in our work. Our able and distinguished colleague, Dr Krishnan, whispered into my ears "Please don't hurry Dr Bhabha too much. He does not like to be hustled further." I reminded him of a London story. The bus conductress was being rude to her driver. "Get a move on. Can't you? What do you think you are doing?" The passengers were amused. "You had better be careful" said one of them, "He will get angry." "He would not dare," said the bus conductress. "He is my husband." I told Dr Krishnan, "Bhabha would not be annoyed with me. He is my driver and my boss and steerman of the Atomic Energy Commission, but I am his bus conductor, his security, so we cannot differ from each other violently or not give each other a hearing." This story is just a prelude to my appreciation of Dr Bhabha's qualities as a co-worker. I can say with sincerity that one could not expect a more conscientious and considerate colleague than Dr Bhabha.'

Excerpt from Sir S.S. Bhatnagar's speech at the Foundation Stone Laying Ceremony, 1 January 1954.

Facing Page Top: Bhabha shows Nehru's model of the new building, as Bhatnagar and Morarji Desai and J.D. Choksi look on. M.C. Chagla is seen in the background. 1954.

Facing Page Bottom: A joyous moment as Nehru lays the Foundation Stone. Bhabha is seen behind him.

Förelag: Prof. H. J. Bhabha, Bombay.

Förelagsställare: Prof. J. Hadamard, Paris.

Inkom den 17. 10. 1952.

INSTITUT DE FRANCE
ACADEMIE
DES SCIENCES

Paris, le 8 octobre 52.

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A Monsieur le Président
du Comité Nobel pour la Physique.

Monsieur le Président

Votre lettre m'invitant à proposer un candidat pour le Prix Nobel de Physique est accompagnée d'une liste des Prix décernés jusqu'à présent. Cette liste ne fait pas mention de l'année 1952: je pense donc qu'aucun Prix Nobel n'a été décerné pour cette année là.

En 1951, considérant l'importance des recherches exécutées relativement aux rayons cosmiques par le Professeur BHABHA, à Bombay, j'avais proposé sa candidature. Je renouvelle donc cette proposition.

Recevez, Monsieur le Président, l'assurance de mes meilleurs sentiments.

J. Hadamard

11341

Professeur J. Hadamard
12 Rue Emile Faguet
Paris XIV^e

The French Mathematician Jaques Hadamard (1865-1963), nominated Bhabha several times for the Nobel Prize in Physics for his work in cosmic radiation. The committee noted that while Bhabha's contributions were important it could not recommend him for the prize.

1951 prize

The French mathematician J. Hadamard has, without providing an extensive reason, nominated Bhabha for his work on radiation, in particular cosmic radiation. Bhabha has, partly in collaboration with other scientists, contributed greatly to the theory of cosmic radiation. In 1937, Bhabha and W. Heitler formulated the so-called cascade theory for soft showers. This theory is now generally accepted. At the same time these results were obtained independently by Carlson and Oppenheimer. Crucially, Bhabha was also the first to realize that Yukawa's theory for mesons implies that even a free meson decays spontaneously to an electron and a neutrino. He also pointed out the relevance of this observation to absorption of cosmic radiation. Bhabha has also obtained other important results regarding the theory of cosmic radiation. In addition, he formulated interesting theories about elementary particles. However, the committee finds that, even though Bhabha's contributions have been very important, it cannot at the present time recommend him for the prize.

1953 prize

Regarding the nominations of Professors Alvarez, Anderson, Auger, Barnett, Bekesy, Bhabha, Born, Bothe, Cabannes, Kapitza, Lattes, Muller, Occhialini, Onsager, Panofsky, Street, Swann, Uhlenbeck and Goudsmit, the committee notes that it has already investigated them recently. Since then, no new developments which could change the conclusions have occurred. For this reason, the committee refers to its previous findings regarding these nominees.

1955 prize

Professor Hadamard in Paris once again nominates Professor H. J. Bhabha, India for the prize in physics for his work related to cosmic radiation.

1956 prize

Regarding nominees Bhabha, Blau and Leprince-Ringuet within this group, the committee refers to its previous findings, since no new developments which could change the conclusions have occurred.

Translated excerpts from the reports from the Nobel Archive.

From the beginning the workshop was seen as playing a very significant part in the Institute.

The TIFR workshop started in the large dining room of the Kenilworth bungalow. It was here that war surplus equipment was recycled, redesigned and standardized for use in experiments. The Glass Blowing Section, one of the oldest sections of the Institute, started with H.L.N. Murthy as one of the glass blowers. Murthy made Geiger-Muller counters which were used in cosmic ray research. The workshop undertook precision jobs for Cloud Chamber experiments. In 1953, the Central Workshop was involved in work on the Van de Graaff accelerator and the thin lens spectrometer. The same year the workshop undertook the installation of the Cascade Generator.

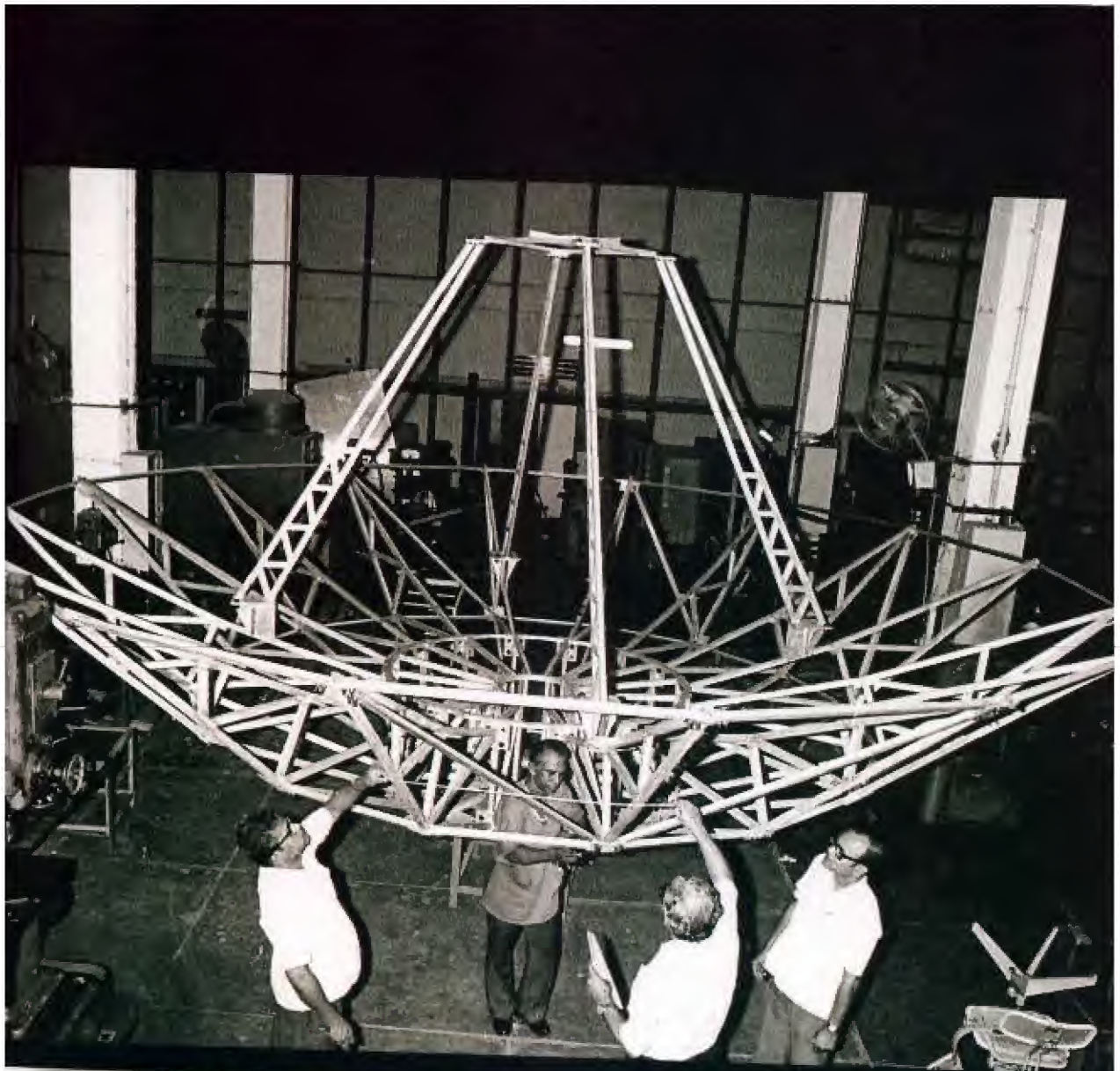
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'We made everything at the workshop. We made antennae and later, even the chairs in the auditorium. Whenever Dr Bhabha came to the workshop – he would show us how we should do things. He would make drawings and show us. The Bhabha trolley used in TIFR was designed by him – he gave the drawings and designed the trolley himself.

He loved the pattern of the grains on wood. If the plywood didn't have the grain pattern he would ask us to send it back. He loved the Tata grey. He loved white polish on the furniture – and he liked a dull finish – it shouldn't shine, he would say. How many times he would make us polish the doors! Till he was satisfied we had to do it. He was very finicky.'

11361

Suresh H. Sawant joined the TIFR Workshop in 1964.



Top: 6.1 metre parabolic antenna being fabricated at TIFR workshop, c. 1960s.
Bottom: A glass blower at work at TIFR's glass blowing section.



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11581



In 1955 TIFR initiated a programme to develop a new technology of zero pressure plastic (polyethylene) balloons. The Balloon production group was moved into the basement of the new buildings when it was ready in 1956. The TIFR Balloon Group also invented the Black Balloon technique and the first successful balloon flight was made from the campus grounds of the Osmania University, Hyderabad in February 1960.

PUBLICATIONS WHILE AT BOMBAY: After he founded TIFR, Bhabha continued his study of cosmic rays. He made a preliminary beginning in nuclear emulsions by flying Ilford C2 plates loaded with boron in an airplane at an altitude of 8000 feet for 72 hours. The result was an example of 'meson scattering' with nuclear excitation. His last paper on multiple meson production was reported at a conference on theoretical physics in Tokyo.

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11401

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Homi Bhabha seen with Murray Gell-Mann and R.H. Dalitz at the first Summer School in Theoretical Physics held in Bangalore in 1961. M.G.K. Menon is seen sixth from left.

Prahlad Chunital Vaidya (1918-2010) was a research worker at TIFR in 1947. Prior to joining TIFR, Vaidya had discovered an elegant solution to Einstein's equation for a radiating star while working with Professor V.V. Narlikar at Benaras Hindu University.

In 1945-46, TIFR was the only place for doing research work in theoretical physics – so I applied. I had already discovered the gravitational field of a radiating star and I wanted somebody in this country to understand what I have done. Therefore I wrote to Bhabha and he called me. At TIFR there was a bunch of research workers who sat together from nine in the morning to five in the evening in the same room carrying out discussions among themselves. That created an atmosphere which created a faith in us young people. I must appreciate that Bhabha could recognize my inner instinct for original work – that was a very big achievement for him as a teacher, and that made me familiar with my own capacity and helped me in further work. At TIFR I realized what research work is, how you could create new ideas and appreciate modern ideas – all this I learnt there – universities or colleges would not teach you that. I stayed there for ten months – I was already married with two children and I didn't get any accommodation, so I left.

In 1947 I was at TIFR at Kenilworth on Pedder Road. On 15 August we had to hoist the flag – it was the first Independence Day. Before joining TIFR I was in the national movement therefore I knew how to hoist a flag. I took the flag, rolled it up and we unfurled the flag. When Bhabha came he asked, 'Where is the flag?' I said, 'There it is.' Then he said, 'No! On the first day of independence you don't unfurl the flag – you raise the flag. Bring it down!' And after that we raised the flag, and everyone sang *Jana gana mana*. Raising the flag! Now that is something I learnt from Bhabha. This incident made me feel that even a famous scientist is an ordinary citizen.

B.V. Sreekantan (b. 1925), cosmic ray physicist, joined TIFR in 1948 as a researcher and was director TIFR 1975-1987. Encouraged by Bhabha he undertook cosmic ray experiments at Ooty and at the Kolar Gold Fields. Here he recollects the KGF experiments which began with the intention of examining whether the muon was the only penetrating charged particle underground.

In late 1950, Dr Bhabha organized an international conference on elementary particle physics. Around that time, he called me and said, 'Sreekantan, you are doing this experiment on muon decay



Phase-I Nucleon
Decay Detector
at Kolar Gold
Fields

and we have the apparatus ready, I want you to take this down the Kolar gold mines and find out whether all the particles underground are μ -mesons or whether there are some other kind of particles. Dr. Bhabha had worked on particles of various spins. So, he was looking for something new other than π -mesons and μ -mesons. He thought that it would be interesting to know the composition of particles underground. The equipment was designed and fabricated in Bombay at the workshop. It was quite challenging because at that time, very little was known about what we now call micro-second electronics. We would use the facilities – the large lifts and cages at the Kolar gold mines to take the huge equipment underground. We started the experiment some time in December 1951 and then he wrote to me saying that, 'Sreekantari, I am coming to Bangalore and I would like to come to the mines and see your experiments.' He came, but it happened to be the 24th of December, Christmas Eve – the mines were closed; but the superintendent, made special arrangements to go down the mines and Bhabha also came and saw our equipment.

B.M. Udgaonkar (b. 1927), theoretical particle physicist and science educator, joined TIFR in 1949. Later, Udgaonkar founded the Homi Bhabha Centre for Science Education together with his

colleague V.G. Kulkarni. He recalls here his meetings with Homi Bhabha at TIFR.

In 1949 I came to the interview for admission into TIFR. Bhabha was there. He was assisted in the interview by Dr Shanmukhadassam, a Sri Lankan visitor. When the latter asked some question related to a topic which I was not expected to have studied at MSc., Bhabha immediately realized this, and turned the questioning towards topics I had studied and he tried to probe my understanding in depth. This episode has stuck in my mind, not only because the course of the interview was a decisive factor in my career, but also because it represented a lesson with regard to conducting interviews, especially of young students, which has influenced me and several of my colleagues.

Dr Bhabha was a good teacher and occasionally gave seminars at the Institute. He continued to work on his own theory of elementary particles with some students working on aspects of it. And he always made sure that all students were exposed to developments at/near the frontier through the lectures by international experts. One thing that stands out from that period as a research student with Dr Bhabha is that he did not put his name on the two papers (the only ones) that I did

The lounge adjacent to the West canteen at the Institute has a view of the garden and the sea. The furniture seen here was fabricated at the Institute workshop.



with him. This too was a lesson for me, especially as the practice is very common in our country.

Yash Pal (b. 1926), cosmic ray physicist, educator and populariser of science, began his scientific career at TIFR as a researcher in cosmic rays in 1949. He built SAC Ahmedabad and ran the SITE programme (1975-1976). He was chairman UGC (1986-1991). He had several close interactions with Bhabha which he recounts here.

Often a new painting would be bought or a new sculpture would be purchased and it had to be placed somewhere and somehow I ended up with Bhabha going around to find out which was the best place to put it. Then when the TIFR auditorium was getting ready and a big problem which Bhabha had was what kind of furniture it should have. The chairs came from all sorts of designers and furniture houses to be tried. I was very often there to sit and try out which was nice and so on. But Bhabha would just not be comfortable – he'd say – this is not nice, this one's too heavy; this is not elegant and so on. Finally the design for the aluminium chairs was worked out. Bhabha decided that nobody else could make it, and so all the chairs were made

in the TIFR workshop. Such things left an impression on me. I learnt that things had to be done just right! He kept on saying during the faculty meetings, 'I want to create a good life.'

Devendra Lal (b. 1929), FRS, geophysicist, began his scientific career as a researcher in cosmic rays at TIFR in 1949. He was Director of the Physical Research Laboratory, Ahmedabad from 1972 to 1983. He is currently based at the Scripps Institute of Oceanography, La Jolla, USA.

DL: One of the ideas at that time was to see what the flux of very high energy protons was and the way to do it was to put, between emulsions, very thin lead sheets. Ultimately, secondary electron showers developed. So, the way to find a high-energy event was, you go deep down in the stack and look for the showers and trace back. Bernard Peters gave me this particular stack and he said, 'Why don't you measure this and find out the flux of very high-energy protons?' I had a total of about 20 events and that was sufficient to get the flux. So, I had done all these calculations. This required lots of geometry calculations. Peters asked me to give him my notebook and then he called George Sudarshan. He said, 'These are the events Lal has found. Will you calculate the flux of the particles independently?' Luckily for me, it was exactly on dot. So he said, 'Okay Lal, you write-up this paper.' He said, 'You will publish this paper in the *Proceedings of the Indian Academy of Sciences* journal.' I actually had a meeting with Peters and Bhabha and he read this paper and asked me lots of questions. He said, 'I approve that this paper should be published.' You know, that gave me tremendous encouragement. This was really wonderful.

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11481

IC: And it's also an exercise in confidence-building.

DL: Right. So that's what Peters and Bhabha were all trying to do at the Institute. And the work with the multiple discoveries, like elementary particles, high-energy interactions, fluxes of very high-energy protons – everything happened within two to three years. It was so exciting. We were completely thrilled and we felt that we could do anything.

Ennackal Chandy George Sudarshan (formerly EC George, b. 1931), physicist, began his career at TIFR in 1952. He did his PhD with Robert Marshak at the University of Rochester. He is professor at the University of Texas, Austin.

ADG: Would Bhabha ask questions at the Wednesday Colloquiums?

GS: Yes. He usually asked one or two questions, which clarified the whole thing. There were people who talked about their research and not many could follow much. But Bhabha somehow understood. So we were under the impression that Bhabha knew everything! The only exception was when Norbert Weiner came. Usually nobody asked Bhabha a question; he was the one to ask. After his talk, Weiner sat on the table and started asking questions. He asked Bhabha also and he did not know the answer. We were very impressed that there was at least one man who could ask Dr Bhabha a question and to which he did not have the answer! Unfortunately, apart from these Colloquium visits, Dr Bhabha was very busy. Bhabha was a very good theoretical physicist except that eventually his ambition went into building atomic energy. He was a scientist, a philosopher, an architect. You know Bhabha used to

have very clear ideas about everything! He was very aristocratic. Every room at TIFR now has flowers. This is Bhabha's legacy. He believed in big things and he used all his influence to get them.

M.G.K. Menon (b. 1928), FRS, cosmic ray physicist, joined TIFR in 1955 after completing his PhD from Bristol University with Cecil Powell. He became the director of TIFR after Bhabha's death in 1966. Menon has played a significant role in the advancement of science and technology and the development of science policy in India.

I came to TIFR in 1955. I had a clear invitation from Homi Bhabha and also Bernard Peters. Peters was then the head of the Cosmic Ray Group at TIFR and I had come to the Old Yacht Club where I had to see Dr Bhabha. I saw him and it was rather late and he was very warm and welcoming in his own way. He was glad that I had come and I was joining, and we discussed what I could do. He discussed with me what I should be in the Institute, in terms of the position he could offer. I think he made one quite telling remark. He said that he would have no difficulty in appointing me on the basis of my background as a professor. He said that as it stands at the moment, if you look at the age structure at the Institute, they were all older people. Therefore, if somebody new and brash came in with a higher standing in terms of the position or salary, they wouldn't look on it very kindly. They were all doing independent areas of work, and they had accomplished much and were doing it under difficult conditions. So therefore, he said, that the best thing would be not to start there. His idea was to appoint me at the bottom of the scale as a reader and then he said that, 'Once

M.G.K. Menon at
a balloon flight



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you are here and once they recognize your merit and class and know what you can deliver, there will be no objection to your going up. But they wouldn't want that to happen by coming in from the outside." I told him that these things were not of great concern to me and he could decide what was appropriate in the interest of the institution. As far as I was concerned, I had decided to come and I was going to join.

Virendra Singh (b. 1938) is a theoretical physicist. He joined TIFR in 1957 and went to Berkeley for his PhD. He was director TIFR from 1987-1997.

In 1957 TIFR had advertised for experimental physics – actually they were not going to take anybody in theory. The first day of the interview there was Gaurang Yadhav – who had done his PhD from Chicago and Sachidanand Jha. This was the preliminary interview and I cleared it. I came to the second interview – in which Peters was the chairman, M.G.K. Menon and Ramanna were members. The latest thing those days was

beta decay and parity violation. So they probably thought I would not know that but I was aware of that. Whatever they asked – I had no problem answering. The only problem I had was Peters' accent which I couldn't quite follow, so Menon would have to repeat it in Indian English before I could answer. [Laughs] But there was no problem that stumped me. They were also shocked because I was coming from the boondocks. Eventually they said do you want to join theory? I thought they were trying to trick me – as they had no vacancy in theory. I said if the choice is between theory and experiment – then it is theory, of course if the choice is between experimental research and no research then it is experiment. Then they said, "You wait, we will arrange an interview with Bhabha."

I waited for Bhabha. He finally called me around 8 pm. He said, "What is it that you have studied?" So I told him what I had studied and what I hadn't studied yet – like I knew tensors, but didn't know spinors. He said, don't worry, you will pick them up. He was alone. There was certainly an aura about him. That was the first time I was seeing somebody in such a huge office. And also he was working late. After meeting me he was going to continue to work – I felt then that that was the right sort of thing. I think he must have put me at ease because I could answer the questions.

Sudhanshu S. Jha (b. 1940), physicist, began his research career at TIFR in 1957. Jha did his PhD at Stanford with Felix Bloch. Jha went on to become the director of TIFR (1997-2002).

In 1960, when I showed interest in going to US for doctoral research, it was

Professor Bhabha and Professor S. S. Dharmatti who suggested that I should write to the Nobel Laureate, Prof. Felix Bloch, to work with him at Stanford University. That is how I obtained my admission and a research assistantship to work for my PhD.

For the first three years of my stay at Stanford, TIFR sent my study leave salary to my parents. Dr Bhabha was of the firm opinion that while students worked abroad for their doctoral degree they should not be burdened with financial worries about supporting their families in India. This was an example of a fine sentiment showing how much Dr Bhabha cared for his staff.

One of the most memorable days in my academic career was the day I gave my first Wednesday Physics Colloquium at TIFR after my PhD from Stanford. This was in 1965. I was somewhat nervous and apprehensive while preparing for the Colloquium. By then, I had already realized that Dr. Homi Bhabha was in the Institute on that day, and he was likely to attend the Colloquium. At that time, most of us considered Dr Bhabha to be our 'idol', and we were always in awe of his personality and his presence. Sure enough, Dr Bhabha was in the audience at the Colloquium, occupying his usual seat in the front row of the modern Lecture Theatre. After I finished my one hour talk on optical nonlinearities in metals, a few clarifying questions were asked by members of the audience. But, Dr Bhabha remained silent throughout the Colloquium, looking very serious all the time. I remained apprehensive. But, imagine the state of my mind and the great feeling it generated, when I saw Dr Bhabha getting up and telling within my earshot, one of the senior members of

the Institute Faculty - 'It was a good talk. Good work'. This was surprising because it was unusual for Dr Bhabha to express his views in this way. Perhaps, those remarks were not meant for my ears, but I have always cherished those inspiring words of appreciation. They gave me great confidence in myself and in my future scientific outlook.

Rangaswamy Narasimhan (1926-2007), computer scientist who designed India's first general purpose digital computer the TIFRAC, joined TIFR in 1959.

Bhabha had offered me a junior research fellowship for Rs 410 as my basic salary. I wrote to Dr Bhabha saying I should like some additional increments at least in the grade. Dr Bhabha's standard reply in these cases was, 'Why do you want money? When I was of your age I didn't have any salary!' [Laughs] He did not alter the grade, instead of Rs 410 he offered me Rs 470. And after that there was no sense in bargaining with him.

He said he would like to get a computer group started and asked what kind of background I had in computers, whether I knew the von Neumann Report, which was a classic. So I told him I had read all that. At the Institute, there was already a group of people who were building logical circuits and things like that. So we tried to put all this together and build a computer. After I arrived, Bhabha first personally and officially got involved in the project when I gave a seminar on the logical aspects of computers and what could be done if the project was granted. And it was taken for granted as a statement of what we hoped to do and what could be done, and the seminar was attended by all the big shots.

Homi Bhabha, R. Narasimhan and Sir John and Lady Cockcroft seen with the TIFRAC, 1961.



J.V. Kotwal (b. 1919) began his career as the Establishment Officer at TIFR. He went on to become the secretary of the Physics Faculty and later, also the deputy registrar.

In 1961, the first Summer School in Nuclear Physics was held at the Indian Institute of Science, Bangalore. In the year 1961, we had Murray Gell-Man and Dick Dalitz. Murray Gell-Man was very young and within two years I think he got the Nobel Prize for physics, and Dick Dalitz was FRS. The Summer School used to start at 9.30. I think 9.30 to 10.30 was the first lecture, then 10.30 to 11.00 was time for questions, 11.00 to 11.30 coffee break, 11.30 to 12.30 there was another lecture, 12.30 to 1.00 again questions, 1 o'clock was lunch – we had a local caterer, Koshy's, catering for us. During that entire period Bhabha stayed at the Westend Hotel. Every day he used to come in his car from Westend and attend the lectures. Bhabha used to sit like a student in the first row and ask questions.

Obaid Siddiqi (b. 1932), FRS, molecular biologist, joined TIFR in 1962 and set up the molecular biology group at the Institute. Siddiqi had done his PhD. in Genetics at Glasgow with Guido Pontecorvo.

Bhabha took a lot of interest in structure and construction. He asked me to make

plans for these two floors which were going to be added to the B Block where I would have the biology lab. I made the floor drawings and put in what I wanted. I had no experience of how to design a lab. Looking back, I think what I made was a pretty cluttered thing because I had divided it too much and made little rooms here and there. Bhabha looked at this and he didn't like it. He took the drawing back to his office – he had an office at his house where there was a drawing table – he used to sit and work there. A week later he called me – he had put blue pencil marks all over my drawing! Then after a discussion, I redid the drawing of the two labs and sent it back to him. After some time, one day, he stopped me on the floor and said, 'Don't you think it looks much nicer, after it was redone?'

Govind Swarup (b. 1929), FRS, radio astronomer, joined TIFR in 1963 after obtaining his PhD from Stanford. With support and encouragement from Homi Bhabha, Swarup set up a solar interferometer and later the Ooty Radio Telescope. Swarup and his group went on to build the Giant Metre Wave Radio telescope at Khodad, near Pune.

Bhabha decided to visit Ooty in May 1965. There were two sites in Ooty and he said he must go and select one. I was unwell with an appendix problem, so Sinha accompanied him. Venkataraman was the Minister for Industries and Bhaktavatchalam was the Chief Minister. They made Bhabha a state guest and the chief engineer came too. Bhabha made everyone run after him down the slopes. The chief engineer was not such a healthy man and had a paunch. And Bhabha was running and saying, 'Let's see if this man falls!' He went fast and they were trying to



Above: The Jodhpur Radio Telescope

Left: Maury Fox, Ubaid Siddiqi and Marty Gellart at the Winter School in Molecular Biology, TIFR, 1967-68.

keep pace with him. Bhabha had a sense of humour. He could be child-like in his way of dealing with people. That's my impression.

Ramanath Cowsik (b. 1940), astrophysicist, began his career at the Atomic Energy Training School and joined TIFR in 1961. He recollects his observations as a young researcher at TIFR.

From 1956 onwards Bhabha was focusing attention on the development of the Atomic Energy programme, so he had sent a note saying that from now onwards 'I shall not be called Professor Bhabha because I shall not be doing any teaching and my research work may be confined to one or two hours a day and I don't want to be called Professor when I am not doing that job. So everybody should call me 'Dr Bhabha.'

Around that time he would spend the whole of Wednesday at the Institute. You would see him around 7.30 or 7.45 a.m. - and he would be wearing a Bush-coat with pockets. He'd have an entourage of people

- the administrator Allardice and one or two others - and he would walk around the whole Institute giving instructions about the garden, the building etc. Then around 9.00 a.m. he would disappear into his office. The Faculty meeting was at 11.00 a.m. and lunch would be had at the Faculty dining room. After lunch he would go back in his office. After that he would emerge at 4.00 p.m. for the Colloquium. By the time he came to the Colloquium he would have changed into a day suit - dark brown or grey. He would occupy a particular chair in the lecture hall and he would look back over his shoulder to see who was there. After the Colloquium he would go back to his office. Next - by accident you might see him again at about 11.30 p.m. at night - he would be dressed in a dark evening suit - very freshly shaven.

Dr Bhabha was a very considerate and a helpful individual: he recognized that we came from backgrounds which were not same as his - we were pretty much country bumpkins. For example many people did not know that they had to tuck

their shirts in – the shirt would be outside. So one day, he called one of my friends. We were all scared. But Dr Bhabha talked to him gently asking him how he was and what work he was doing etc and then said, 'Ah, you know it is good if you tuck your shirt in, everybody seems to do that and we should have similar discipline and decorum and style of functioning.' He said it in his own polite way without making this man feel bad about it – he didn't shout and said it out of the hearing of all his friends too. Our friend came and reported it. That's how we knew what had transpired.

Dinesh Daftary (b. 1936), dental surgeon, was an Honorary Oral Pathologist at the Basic Dental Unit at TIFR. This Centre became the WHO Collaborating Centre for Oral Cancer Prevention in 1966.

I think it was in 1964 that I met Dr Bhabha at the Chambers of Dr Fali Mehta, who had set up the Basic Dental Unit at TIFR. The place was near Kemp's Corner. It was around 9.00 or 9.15 in the morning and Dr Bhabha came sauntering down Hanging Gardens with his dog. He was in shorts. Dr Mehta had wanted to start research in oral cancer at the Dental Unit at TIFR and Dr Bhabha was very encouraging. He wanted to interview me himself. We talked about various things. He asked a few questions about my previous experience – I had worked with Dr Mehta on leukoplakia. Dr Bhabha was very happy when I told him that one can understand the whole history of oral

cancer by looking at how lesions in the mouth change. After that I joined. He encouraged Dr Mehta and me and we built a team. We did a massive amount of population-based studies on different kinds of oral lesions and catalogued different smoking and chewing habits. Our work gained recognition and we became the WHO Centre for Oral Cancer prevention.

Sundararaman Ramanan (b. 1936), mathematician, joined TIFR in 1956 as a researcher in mathematics. He recounts an interesting encounter with Homi Bhabha.

There was a place called 'Rendezvous' – where the Taj Intercontinental now stands – and it was a tradition that the new students had to treat all the senior people. In the Institute there was a small group at the time, so we usually invited all our seniors, including Bhabha and Chandrasekharan. So I took everyone to 'Rendezvous' for tea in the evening. And here I was coming from a lower middle class family in Chennai – I didn't know how to handle my fork and spoon at all. Then some samosas arrived. And I tried to cut it and the pieces started going all over the place. It so happened that Bhabha was sitting next to me. He took one look and then he just picked up the samosa with his hand and bit it. And it was absolutely clear to me that he was telling me that I didn't have to struggle like this. And I was really pleased and also very relieved. It was a very nice gesture.

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Bhikha visited
Czechoslovakia in 1961.
He is seen here at
Skoda-works Plzeň.



30/10
PRIME MINISTER'S HOUSE,
NEW DELHI.
19th November 1932.
4. 10/11/32

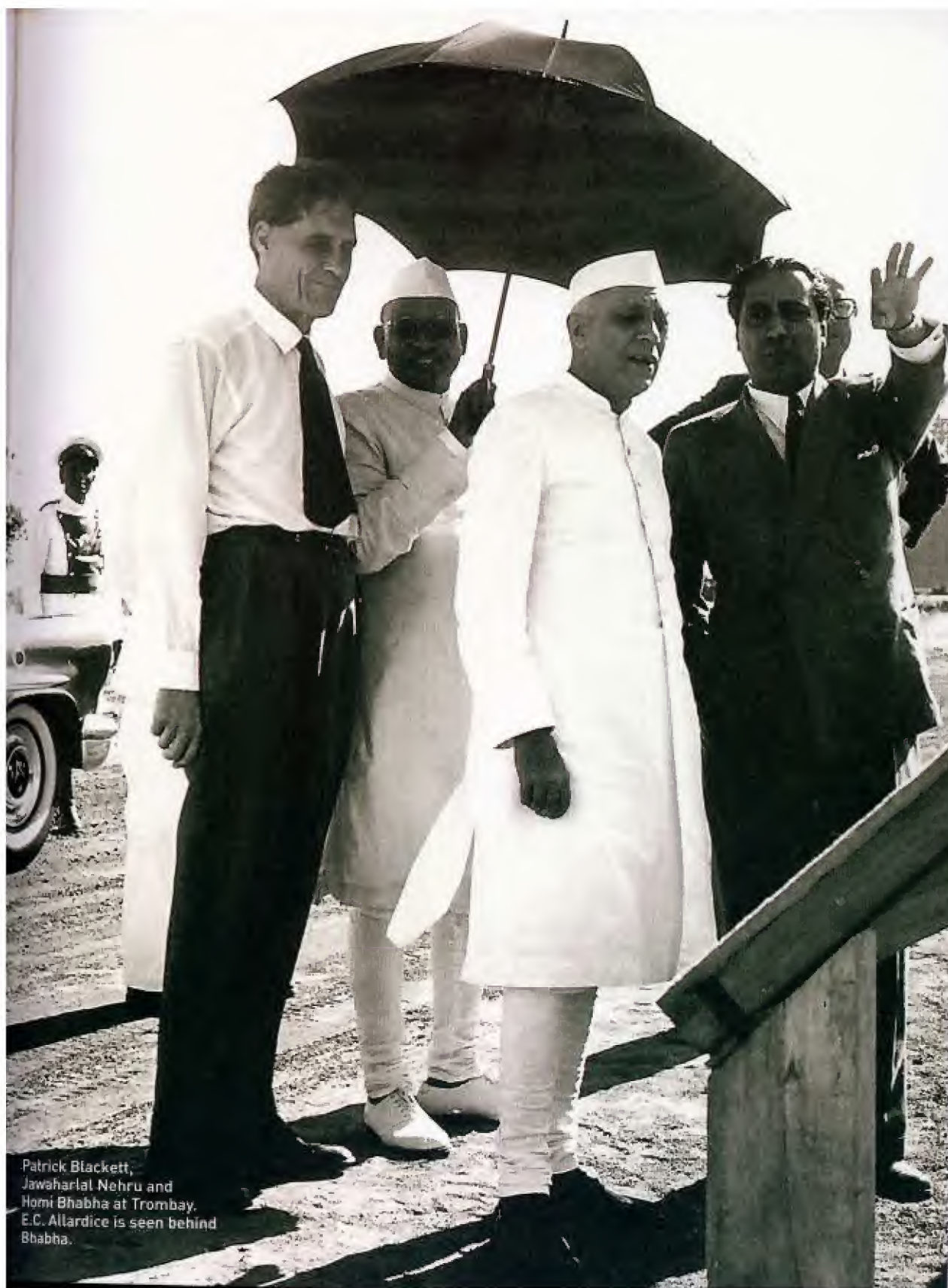
7. DEAR BHAI

'It is in meeting these scientists and finding out what they have been doing, that I have felt so hopeful, so optimistic about the future of science in India.'

Jawaharlal Nehru, speech at inauguration of TIFR building, 15 January 1962.

Jawaharlal Nehru

The first meeting between Bhabha and Nehru is not historically recorded. Indira Gandhi recalled in her speech at the inauguration of the Homi Bhabha auditorium in Bombay that she first met Bhabha when she was travelling with her father by ship to Marseilles in 1938. Nehru, twenty years older than Bhabha, went to Cambridge when Bhabha was still a schoolboy in Bombay. It is not difficult to imagine that the young Bhabha might have first chanced upon Nehru at the house of his uncle, Sir Dorabji Tata, where many leaders of the Indian National Congress gathered. But in the years that followed Indian independence their friendship became stronger and more intimate. Nehru was among the few statesmen who approached science with a natural curiosity and an instinctive ease – something that further strengthened his unusual friendship with Bhabha. The young scientist addressed Nehru as 'Dear Bhai' and Nehru addressed Bhabha as 'My dear Homi'. Years later, Mrs Indira Gandhi would recall how her father always found time to talk to Bhabha no matter how late it was not because Bhabha brought to him urgent matters that required his immediate attention but because such conversations were refreshing, satisfying perhaps an unfulfilled need for intellectual company that his life in politics denied him.



Patrick Blackett,
Jawaharlal Nehru and
Homi Bhabha at Trombay.
E.C. Allardice is seen behind
Bhabha.

Nehru visited TIFR and the AEET whenever he visited Bombay. As Patrick Blackett who often stayed as a house guest at the Prime Minister's residence observed, Nehru 'liked intellectual company and did not get it except in Homi and people like that.'

Dear Bhai



Top Left: Bhabha introduces K. Chandrasekharan to Nehru while Raja Ramanna, E.C. Allardice and Rustum Choksi look on, 1962.



Top Right: Bhabha and Nehru at an inaugural exhibition at TIFR. B.V. Sreekantan is seen in the background, 1962.



Bottom: Nehru names the TIFR Computer 'TIFRAC' while D.Y. Phadke and Bhabha look on.

Bhabha often discussed with Nehru ways of bringing research laboratories and advanced scientific education closer.

28 02 52 HOMI TO BHAI

My dear Bhai,

I am writing to remind you of certain general proposals regarding the administration of higher scientific and technical education and research which I believe have met with your general approval in the past, but which have not been put into effect for various reasons. The present juncture after the elections may perhaps be a suitable moment for putting them into effect.

The separation of advanced scientific and technical teaching from research is not desirable. The reasons for this have been elaborated at somewhat greater length in the attached sheet which is an extract from a Note I submitted to the Planning Commission in September, 1950. Far closer cooperation could be established between the scientific departments of the universities and the national laboratories if the two were dealt with by the same Ministry. It is desirable that higher scientific education, meaning thereby scientific education at the university stage, should be dealt with by the same Ministry as deals with scientific research, whereas the pre-university scientific education could be dealt with by the Ministry of Education as at present. This would be a far more natural and logical division of functions between the two Ministries than the present one. In any case, the fact that the national laboratories, which are the best equipped and most up to date scientific laboratories in India, are under the Ministry of Natural Resources and Scientific Research while a number of other scientific institutions doing advanced teaching and research such as the Indian Institute of Science at Bangalore are under the Ministry of Education is the cause of a considerable lack of coordination, unnecessary duplication, and waste. There seems no doubt that the natural place for the institutes of higher technology and science like the Indian Institute of Science is under the Ministry that deals with scientific research.

Yours sincerely,

Homi

The Hon'ble Jawaharlal Nehru,
Prime Minister
New Delhi

Ministry of External Affairs

Writing to Nehru about the prevalent atmosphere at his Institute, Bhabha wrote: 'Often, when I have left the Institute at eight in the evening, I have seen junior members of the staff reading in the library or working at their apparatus.'

11.01.54 HOMI TO BHAI

Pandit Jawaharlal Nehru,
Prime Minister,
Government of India,
NEW DELHI

My dear Bhai,

Dear Bhai

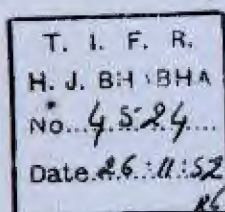
Now that the frantic rush which preceded and accompanied the function on the 1st of January is over, I would like to thank you once more for having agreed to lay the foundation stone of the Institute. Apart from making it possible for us to start building operations this month, which would otherwise have been impossible, your agreeing to take part in the function has been a source of great encouragement to the staff of the Institute, and I am sure will bring forth from them even greater efforts than in the past. Often, when I have left the Institute at 8 in the evening, I have seen junior members of the staff reading in the library or working at their apparatus. The entrance register shows that many theoretical workers come in after dinner and work till midnight, while experimental workers have on occasion worked through the night, when their experiments demanded it. It is our aim to maintain and to increase this tempo and enthusiasm.

I cannot sufficiently express to you – and here I speak for the Council and the entire staff of the Institute – our appreciation and gratitude for your interest and support, which have made it possible for us to do what we could to add to the progress of science in India.

Yours sincerely,

Homi Bhabha.

11581



3 (1/1)
PRIME MINISTER'S HOUSE,
NEW DELHI.
19TH NOVEMBER 1952.

4 [Signature]

Writing to Nehru about the prevalent atmosphere at his Institute, Bhabha wrote: 'Often, when I have left the Institute at eight in the evening, I have seen junior members of the staff reading in the library or working at their apparatus.'

TI 01 54 HOMI TO BHAI

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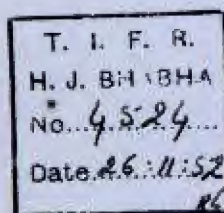
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11581



3 (1/1)
PRIME MINISTER'S HOUSE,
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19TH NOVEMBER 1952.

Y. K. P. N.

Bhabha was conferred an honorary Doctor of Science at Cambridge in 1959. This excerpt from a letter he wrote Nehru right after his visit reveals not only the intimacy he shared with India's first Prime Minister but also expresses a yearning to build institutions that would have a lasting beauty of their own.

'I enjoyed the two days I spent in Cambridge in connection with the conferment of an honorary degree of Doctor of Science on me. The ceremony was as usual. Among the other recipients of honorary degrees (of Law, Literature, Science and Music) were Dr Vivian Fuchs who led the recent expedition across the Pole, Le Corbusier (to whom we owe the planning of Chandigarh), the sculptor Henry Moore, the composer Mr Benjamin Brittan, and Mr Louis Clarke, one time curator of the Fitz William Museum. The citations were as usual read out in Latin by the Public Orator, but for the first time a crib with the English translation was distributed to the audience. There was a very large luncheon in the hall of Trinity College immediately after conferment, at the end of which Lord Tedder, Chancellor of the University, made a speech referring to all those on whom a degree had been conferred. I had been asked to reply to his speech on behalf of all the recipients of honorary degrees, and I enclose herewith a copy of my speech. (The text published in the India House bulletin had some mistakes and omissions on it). Being an after-lunch speech, it included a certain number of humorous topical references which may be lost if one is not aware of the local incidents to which they allude. For example, the last paragraph refers to an undergraduate prank which was narrated to me by the Vice-Chancellor, Lord Adrian. One morning the authorities of the University found to their surprise an entire automobile on the roof of the Senate House. How it had been put there overnight is still something of a mystery, in view of the enormous trouble which had to be taken to get it down again without damaging the Senate House.

I stayed in Cambridge at the Master's Lodge in Trinity as the guest of Lord Adrian. This was evidently a particularly good year for roses. I have never seen such profusion of beautiful roses, as was to be found in his garden at the back adjoining the river. The two days in Cambridge, although hectic, were most refreshing. I sometimes wish I could spend 3 to 4 months there in quiet study and contemplation. I hope some of the scientific laboratories and establishments we are building today will have a beauty of their own, which will have its due effect on those who work there. I think both Trombay and the Tata Institute of Fundamental Research will be architecturally, and botanically beautiful, when they are completed.'



Dear Bhar

[160]

'But for me, to the admiration for him is added a warm affection, not only for the friendship which I had for him, but for the friendship he gave to my father, and which I know meant a very great deal to my father. The life of a politician seems to be full of glamour from the outside, but it lacks many of those warm moments of sensitivity that other people take for granted in their everyday life. I know that Homi Bhabha opened one such "window" for my father, and he always found that no matter how tired my father was, no matter how late it was at night, he always found time for Dr Bhabha, not only because the problems which Dr Bhabha brought were important and he wanted to give them urgent attention, but because he found at the same time it was relaxing and it was an entirely new world.'

An excerpt from Prime Minister Indira Gandhi's speech delivered on the occasion of the inauguration of the Homi Bhabha Auditorium, 9 November 1968.



8. THE ATOMIC KINGDOM

'For the full industrialization of the underdeveloped countries, for the continuation of our civilization and its further development, atomic energy is not merely an aid, it is an absolute necessity. The acquisition by man of the knowledge of how to release and use atomic energy must be recognised as the third epoch of human history.'

Excerpt from Dr Bhabha's address at 1955 Geneva Conference

In less than a fortnight after independence, on 26 August 1947 the Board of Research on Atomic Energy was set up with Homi Bhabha as Chairman. Within a year, Bhabha's suggestion of developing atomic energy in India was accepted and the Atomic Energy Act was passed on 10 August 1948. The Atomic Energy Commission now began functioning with Homi Bhabha as chairman, Shanti Swarup Bhatnagar as member-secretary and K.S. Krishnan as member. Bhabha's vision had a broad sweep – he dreamt of training young scientists who would carry out research and at the same time he also envisaged developing industrial capabilities so essential to atomic energy. He began with training. After all, he had assured Sir Sorab in 1944, when he started his Institute – 'when nuclear energy has been successfully applied for power production, in say a couple of decades from now, India will not have to look abroad for its experts but will find them ready at hand.'

Looking for strength within could hardly have been easy. A newly independent country with no industrial infrastructure to speak of could not take for granted technological experience. Bhabha therefore set out to build that capability through the energetic and practical task of assembling and testing electronic and nuclear instruments. In the



Jawaharlal Nehru being taken around the Atomic Energy Establishment at Trombay, during its inauguration, 20 January 1957

early years such activities began in the rooms of the Old Yacht Club, the second home of the Institute, in war-time hutments at Colaba – the site of the permanent buildings – and at makeshift laboratories at Cadell Road. The 1 MeV Cockcroft-Walton generator, also known as the Cascade Generator was installed in a shed inside a hutment at the site of the permanent building, and provided young scientists the opportunity to study nuclear reactions. As he would reiterate years later – 'work has inevitably been built up first and the permanent buildings have come afterwards.'

The Atomic Kingdom

The experience gained by the early groups of scientists served as a rich resource for training young scientists who joined later. When the Atomic Energy Commission began functioning in 1948, the Institute joined in carrying out some of its projects. The senior scientists sometimes held joint appointments. As the Atomic Energy Establishment grew, rapid surveys were undertaken and natural resources for thorium and uranium tracked down and plants for processing monazite sands set up and made operational.

It was inevitable perhaps that Bhabha's duties should increase. By 1954, AEC until then an advisory board became a separate government department. Bhabha now began to function as the secretary to the Department of Atomic Energy. At the same time he also became director of the Atomic Energy Establishment in Trombay even as he continued to function as the chairman of the Atomic Energy Commission and director of TIFR.

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A year later in 1955 the thorium plant at Alwaye became functional. On 4 August 1956 the 1MW Swimming Pool Reactor at Trombay attained criticality. It was the first nuclear reactor in Asia. Soon afterwards a larger

research reactor was built with help from Canada under the Colombo Plan. The Canada India Reactor attained criticality on 10 July 1960. Confidence among the scientists at AEET surged. Zerlina, another research reactor and a plutonium plant followed. Work on such an unprecedented scale was made possible only because Bhabha remained committed to his vision that India after independence would not look abroad for experts for her scientific programmes, and started the AEET Training School in 1957. AEET thus became the nursery where technology could be grown. But there were other concerns that also appeared on the horizon.

With the Cold War showing no signs of abating there was considerable fear that the horrific history of Hiroshima might repeat itself. The First Geneva Conference for the Peaceful Uses of Atomic Energy in August 1955 was perhaps one of the attempts to contain such fears. Homi Bhabha was chosen to be president of the Conference unanimously by the Advisory Committee. He saw the conference as an occasion to discuss and exchange scientific and technical knowledge about atomic energy. He played his role with aplomb, taking the opportunity to present his version of the history of world as a civilizational evolution from one form of energy to another.

Seven years later, when the Indian conflict with China left Nehru a broken man, Bhabha stepped into action – becoming the moving spirit behind the reorganization of scientific research and development. As he began work on the Electronics Committee Report, Bhabha's vision expanded to include building larger technological capabilities that would ensure national security. The transformative powers of nationalism now worked in tandem with science to mobilize a common mission. Bhabha became the man of the hour.

'In a broad view of human history it is possible to discern three great epochs. The first is marked by the emergence of the early civilizations in the valleys of the Euphrates, the Indus, and the Nile, the second by the Industrial Revolution, leading to the civilization in which we live, and the third by the discovery of atomic energy and the dawn of the Atomic Age, which we are just entering. Each epoch marks a change in the energy pattern of society.

In a practical sense, energy is the great prime mover, which makes possible the multitude of actions on which our daily life depends. Indeed, it makes possible life itself.'



Dr. Bhabha addressing the opening session of the 1955
Conference on the Peaceful Uses of Atomic Energy at the
Palais des Nations in Geneva, 8 August 1955. [Photograph by
Thomas D. Mcavoy.]



The Atomic
Kingdom

11701

Facing page: E.C. Allardice looks on as Bhabha points to the blueprint of the *Apsara*.

Below: Bhabha discusses the design of the *Apsara* with his colleagues, K.S. Singhwani, A.P. Rao among others.



'The control system of *Apsara*, the first reactor in Asia was built under the auspices of this Institute in a war time hutment on this very site, and many parts of the reactor in the Institute's workshop. It is not an exaggeration to say that this Institute was the cradle of our atomic energy programme, and if the Atomic Energy Establishment has been able to develop so fast, it is due to the assisted take-off which was given to it by the Institute in the early stages of its development.'

Homi Bhabha, Speech at inauguration of new buildings, TIFR, 15 January 1962.

1954 : DEPARTMENT OF ATOMIC ENERGY CREATED : BHABHA BECOMES SECRETARY TO GOVERNMENT, REPORTING EXCLUSIVELY TO NEHRU

1955 : THORIUM PLANT AT TRAMBAY BECOMES OPERATIONAL : BHABHA PRESIDENT OF GENEVA CONFERENCE ON PEACEFUL USES OF ATOMIC ENERGY

The extraordinary boldness of Bhabha's vision was that he was able to see and imagine Big Science in India. The Atomic Energy Establishment embodied a historical convergence of nationalist self-confidence and technological aspirations.

Atomic Kingdom

Facing Page: Bhabha, Homi Sethna and Col. G. K. Rangappa Menon at the site of the Uranium Metal Plant in Trombay. The Thorium plant (1955) is seen in the background.

Top: Bhabha and Nehru during Pandit Nehru's visit to Trombay.

Bottom, left to right: S. Fareeduddin, Homi Bhabha and others with Prime Minister Lal Bahadur Shastri at the Uranium Metal Plant, Trombay, 1965.

Queen Elizabeth II, the Duke of Edinburgh, Bhabha and his mother Menzoba and others during the Queen's visit to Trombay in 1961.

Homi Bhabha with the Education Minister Mr M. C. Chagla in Trombay, August 1964.





1955 | INDO-BRITISH NUCLEAR ENERGY COOPERATION AGREEMENT IS SIGNED | KHRUSHCHEV AND BULGANIN VISIT INDIA

| FIRST TRUE FUSION DEVICE TEST BY SOVIET UNION DEVELOPED BY ANDREI SAKHAROV 1956 | FIRST INDIAN REACTOR APSARA BECOMES OPERATIONAL

The Atomic
Kingdom

[174]

An aerial view of CIRUS, a research reactor at the Atomic Energy Establishment. CIRUS was modelled on the Chalk River NRX reactor in Canada and reached criticality on 10 July 1960.

1957 | ATOMIC ENERGY ESTABLISHMENT TROMBAY INAUGURATED | AEC TRAINING SCHOOL STARTS | SPUTNIK SATELLITE LAUNCHED BY USSR
| FIRST BRITISH H BOMB TESTED AT CHRISTMAS ISLAND | DEFENCE RESEARCH AND DEVELOPMENT ORGANIZATION ESTABLISHED IN DEL



EMERGENCY COMMITTEE *of* ATOMIC SCIENTISTS 21

INCORPORATED

ROOM 28, 90 NASSAU STREET
PRINCETON, NEW JERSEY

2067 600
21/6

Trustees

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PHILIP M. MORSE

LINUS PAULING

LEO SZILARD

V. F. WEISSKOPF

April 30, 1947

Dear Friend:

I write to you for help at the suggestion of a friend.

Through the release of atomic energy, our generation has brought into the world the most revolutionary force since prehistoric man's discovery of fire. This basic power of the universe cannot be fitted into the outmoded concept of narrow nationalisms. For there is no secret and there is no defense; there is no possibility of control except through the aroused understanding and insistence of the peoples of the world.

We scientists recognize our inescapable responsibility to carry to our fellow citizens an understanding of the simple facts of atomic energy and their implications for society. In this lie our only security and our only hope - we believe that an informed citizenry will act for life and not for death.

We need \$1,000,000 for this great educational task. Sustained by faith in man's ability to control his destiny through the exercise of reason, we have pledged all our strength and our knowledge to this work. I do not hesitate to call upon you to help.

Faithfully yours,

A. Einstein.

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AE/ef

Albert Einstein [1879-1955], most influential physicist and philosopher, was awarded the Nobel Prize in physics 1921. He and Leó Szilárd founded the Emergency Committee of Atomic Scientists (ECAS) in 1946 with the urgent task to educate the public against atomic weapons. The committee disbanded in 1950. Soon afterwards in 1955 the Russell-Einstein manifesto was released which made way for the Pugwash conferences in Science and World Affairs in 1957.

15.07.47 BHABHA TO EINSTEIN

AIR MAIL

Dear Prof. Einstein,

I have to acknowledge your letter of the 30th of April 1947.

I fully agree with its contents, and will do everything I can to help your work. We, Indian scientists, inaugurated at the last meeting of the Indian Science Congress the Association of Scientific Workers of India under the chairmanship of Pandit Jawaharlal Nehru. This Association would be very interested in supporting the work that you are doing, and if you would have your literature sent to us regularly, we shall take steps to have it publicized among the scientists, and the public in India. The literature should either be sent to me at the above address, or, preferably, direct to the General Secretary, Dr B.C. Guha, Government of India, Department of Food (Division III), New Delhi.

While many would gladly subscribe in support of this important work, we would all be prevented from sending our subscriptions to the United States on account of the very stringent dollar restrictions that the Government has been compelled to bring in. However, it seems to me that the most important thing is to give the considered views of scientists on this subject the widest publicity, and to educate the public and our politicians in the matter, and in this work you may be assured of the cooperation of most Indian scientists.

With kind regards and happy memories of our meeting in Princeton,

Yours sincerely

Homi J. Bhabha

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Homi J. Bhabha



The Atomic
Kingdom

1987



Bhabha seen here with Albert Einstein, Hideki Yukawa and John Wheeler c. 1948 at the Institute for Advanced Study, Princeton. (Photograph by Wallace Litwin and Joseph Kringsdorf)

Niels Henrik David Bohr (1885-1962), physicist, was awarded the Nobel Prize in physics in 1922 for his contribution to the understanding of atomic structure and quantum mechanics. Bohr's Open Letter to the United Nations expressed the urgency of nurturing an open world in order to overcome prevalent political tensions between nations. Bohr was awarded the first Atoms for Peace Award in 1957.

UNIVERSITETETS INSTITUT
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TEORETISK FYSIK



BLEDDAMSGVEJ 15-17, KØBENHAVN Ø.
TELEFON: TRIA 1114
TELEGRAMADRESSE: PHYSICUM

DEN June 14th, 1950.

Dear Bhabha,

I was very happy to be able on your visit to Copenhagen to talk with you about the problems, which are so much on the minds of us all. I have now completed an open letter to U. N. which will be delivered to-morrow morning to the General Secretariat at Lake Success and will be released to the World Press in the course of the afternoon.

I am enclosing two copies of the open letter, of which I kindly ask you to communicate one to the Indian Government and if you still agree I should of course be very happy, if you at the same time would express your sympathy with the endeavour and the hope that it in some way may contribute to progress in the direction all nations must wish for.

It is for reason of utmost correctness in the whole matter, that I have not thought it proper to send copies of the open letter to receive for anyone before it has been delivered to U. N. and released to the public, that is also why I first now write to you.

I need not add that your visit was a very great pleasure to my wife and myself and that it shall be a most wonderful experience for us sometime to come to India with the ancient culture and the promising future.

With kindest greetings from us both

yours

P. S. I should be very grateful to have a few words from you, when you have received this letter, and if there is anything you wish me to do without delay, please send me a cable.

I shall in a few days send you some printed copies of the open letter.

HP
17 7/50



Bhabha first met Bohr in 1932 when he travelled to Copenhagen on the Rouse Ball Travelling Studentship from Cambridge. Their relationship endured. Bohr visited TIFR in 1960. Bhabha's sketch of Bohr belongs to the same year.

After Einstein's death in 1955, Bertrand Russell (1872-1970), philosopher and mathematician, worked tirelessly to procure support for a meeting as called for in the Russell-Einstein Manifesto. The first conference was planned to be held in India. However, the Suez crisis intervened and the first Pugwash conference on Science and World Affairs was held in July 1957 at the Canadian village of Pugwash, Nova Scotia. This is an excerpt from Russell's letter to Bhabha.

11.06.58 RUSSELL TO BHABHA

PENRYHNDEUDRAETH, MENONETH, NORTH WALES

The Atomic
Kingdom

Dear Professor Bhabha,

You may be aware that during the past year, two conferences of scientists have been held to discuss the critical problems posed for mankind by the discovery of atomic energy, as well as by other contemporary advances of science. The meetings arose out of the appeal issued under the signature of the late Albert Einstein, nine other distinguished scientists and myself, which directed attention to the dangers resulting from the development of weapons of mass destruction.

The first conference, made possible by the generous financial support of Mr Cyrus Eaton, was held at Pugwash, Nova Scotia, in July 1957. This meeting set up a Continuing Committee, composed of Professors Powell, Rabinowitch, Rotblat and Skobel'tzyn, with myself as Chairman, with instructions to call further meetings should they appear desirable.

The Continuing Committee is now arranging a third meeting to be held in Austria, at Kitzbuhell and Vienna, between September 14th and 21st inclusive. As chairman of the Continuing Committee, I have great pleasure in extending to you an invitation to attend.

Participation in the Austrian meeting will be restricted to about 60 invited scientists, distributed among the different countries in approximately the same way as at Pugwash and at Lac Beauport, but with additional participation from countries which were not then represented. The final sessions in Vienna, are to be open for invited guests.

The Koerner Foundation, of which the President of Austria is the patron, has very generously offered hospitality to the members of the Conference, whilst they are in Austria, and the foundation will be responsible for the organization of the meetings in Vienna. The Continuing Committee has a limited sum at its disposal from which to provide some traveling expenses for the participants. Since, however, the conference is to take place immediately after the termination of the Geneva Atoms-for-Peace Conference, at a season when other scientific meetings are being held in Europe, it is hoped that some of the participants will find that their travelling expenses are provided from other sources.

11821

I should greatly appreciate an early reply to this invitation, with an indication of what traveling expenses you would like us to find.

Please send your answer in care of Professor Eugene Rabinowitch, Box 61, 5734, S. University Avenue, Chicago 37, Illinois, USA.

Yours sincerely

Bertrand Russell.

Jean Frédéric Joliot-Curie [1900-1958], the French physicist and Nobel Laureate, had campaigned for the abolition of nuclear weapons through the World Federation of Scientific Workers and the World Peace Council, the two pro-Soviet organizations he headed. Joliot-Curie was not persuaded by Russell to sign the Einstein-Russell Manifesto. This is an excerpt from his letter to Bhabha.

17.02.55 JOLIOT-CURIE TO BHABHA

PARIS

My dear Bhabha,

I would like first of all to congratulate you on your appointment as chairman of the United Nations Conference called to examine the peaceful uses of atomic energy. This leads us to speak of problems allied to those which will be discussed at the Conference and about which you have already had an opportunity of talking with J.D. Bernal during his visit to India.

A strong movement has manifested itself among the scientific workers of all countries in response to a very wide-spread feeling which can briefly be summarized, 'It is time that scientists did something.' This feeling which was already current before the debates in the United Nations has grown. I express the wishes of a great number of my colleagues in addressing a letter to Mr Van Kleffens which he had distributed to members of the General Assembly. The dreams which I put forward to widen the scope of the Conference and its agenda has received the approval of many of my colleagues amongst which I may mention Otto Hahn (who also wrote to Mr Van Kleffens), H.C. Urey and A. Haddow.

In a general way the feeling is manifesting itself in all directions that it will be a mistake and also a betrayal of public opinion to emphasise exclusively the peaceful uses of atomic energy at a time when the entire world is agitated by the potential of atomic and thermo-nuclear weapons. The fact that individually a number of my colleagues have raised the alarm, as for example, Otto Hahn's broadcast on the German, Danish, Swedish and Norwegian broadcasting systems, has only increased the desire to see the scientific workers of all countries and of all political and philosophical creeds join together to underline these dangers. Such a manifesto, as opposed to individual warnings, would not give rise to any suspicion of bias or political manoeuvre.

The summoning of such an international conference which would usefully round off the Conference could come about at the instance of a group of 10 or 20 scientific workers of the principal countries concerned. Preliminary scientific work should be carried out and it is interesting to see that although nothing specific has yet been decided for the international conference on the subject of the dangers of atomic and thermo-nuclear weapons, national conferences have already been organized in many countries. In India a committee is already sitting preparatory to an Asian conference to be held in April.

I am profoundly convinced that the combination of these efforts undertaken by men of goodwill belonging to many different ideologies will result in the meeting of this conference, which in conjunction with the Conference over which you preside, will make quite clear the hopes and the dangers contained in nuclear energy.

I shall be very glad as soon as possible to have your views on these problems.

With best wishes,

Frédéric Joliot-Curie

The Hindu.

VOL. 78, NO. 388, 4

MADRAS, MONDAY, AUGUST 8, 1955.

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INDIA'S PEACE POLICY

FOREIGN POWERS' APPRECIATION

MR. NEHRU'S REVIEW

LUCKNOW, Aug. 7. Prime Minister Nehru tonight called upon the people to face nuclear calamities with strong determination and co-operate with the Government in alleviating the distress of the stricken people.

Mr. Nehru who was addressing a public meeting here said it was a sad thing that the people were not aware of the danger of atomic energy. There would be no question of the Government taking any action to prevent the use of atomic energy but people were to take lessons from them and adjust their future plans to save of calamities as far as practicable.

He said no particular purpose was served by his aerial survey except that he could study the situation and see the arrangements made in mitigating the miseries and sufferings of the people.

"I saw very little because of the inclement weather. I went to Panaji and could not go to Goa. My plane was also delayed at Delhi on account of bad weather conditions," he said.

The Prime Minister said that it was believed by all Governments that some arrangements had to be made in which people co-operate with Government efforts was essential.

He said that a few thousand villages had been washed away by floods and about 100,000 people were homeless.

DAIRY RESEARCH IN INDIA

MR. A. P. JAIN'S APPEAL

NATIONAL INSTITUTE AT KARNAL

KARNAL, Aug. 7. Mr. A. P. Jain, Minister for Food and Agriculture, said here today that dairy research conducted and sponsored on a national basis, would help the growth of a socialist pattern of life.

Laying the foundation stone of the National Dairy Research Institute, Mr. Jain said that dairying, like agriculture, was one of the basic industries of India. Milk and milk products constituted more than 50 per cent of the national dividend—second to none in all the factory industries put together.

Dairying in India, he said, did not conform to the conventional concept of an industry. The huge quantity of about 1.5 million tonnes of milk produced per day in the country was collected from about 80 million cows and buffaloes, maintained in nearly 40 million small and fragmented holdings scattered throughout the length and breadth of the country.

Situated in the heart of the important dairy belt of India, the institute when it came into full operation will form a close link with the dairy trade and industry, based on information derived from scientific studies and purely trained personnel.

Messages wishing success to the new venture were received from

INDUSTRIES IN MADRAS

SUGGESTION FOR DEVELOPMENT

PLEA FOR LARGER AID FROM GOVT.

MADRAS, Aug. 7. A suggestion that business should be allocated to the various States on the basis of population, for the starting of new industries during the Second Five-Year Plan period, and that a development tax should be levied on industries in highly industrialised areas in India like Madras and Bombay so as to help backward States like Bihar, was made by Mr. A. Anandaramakrishnan while he spoke on "The Second Five-Year Plan of Madras" under the auspices of the Council of Public Affairs of the Congress Party Hall, Law Church Road, this morning.

Mr. N. Anandaramakrishnan, President of the Madras Chamber of Commerce, who was in the chair, said that the Government plan seemed not to be the correct one. He said that the Government plan seemed not to be the correct one. He said that the Government plan seemed not to be the correct one.

Mr. Anandaramakrishnan said that though the State of Madras had a large population, it was not getting its share of industrial development. He said that the Government plan seemed not to be the correct one.

FLOOD HAVOC IN U.P.

APPEAL TO PEOPLE FOR AID

NEHRU'S AERIAL SURVEY

LUCKNOW, Aug. 7. Prime Minister Nehru tonight made a two and half hour aerial survey of the flood-affected districts of U.P.—Bareilly, Fyzabad and Bahraich. He was accompanied by Mr. K. M. Munshi, Mr. Lal Bahadur Shastri, Dr. Sampurnanand and others.

The party landed at Fyzabad where the Prime Minister met about 100 members of the U.P. legislature and presided public meetings in Jaunpur, Fyzabad and Bahraich districts.

Giving his impressions of the day's tour at a Press conference, Mr. Nehru said, "Where there is such huge devastation, no effective work can be done without the close co-operation of the people with the Government agencies. I was happy to find that there had been close co-operation in these areas of Bihar Pradesh. The people generally have faced the misfortune with great heroism. This is a very hopeful and pleasant aspect of the disaster."

Mr. Nehru said the floods had subsided leaving empty land. There had been fortunately very little loss of human life and no much of animal life. The floods had occurred in two rivers and not in big rivers. Such floods had occurred after 40 years.

GREAT DEVASTATION
Mr. Nehru said that there were

PLAN TO HARNESS ATOMS FOR HUMAN WELFARE

WORLD SCIENTISTS MEET TALKS IN GENEVA TODAY

From K. S. SHELIVANKAR

GENEVA, Aug. 7. The Atomic Energy conference opening here on Monday with Dr. Homi Bhabha as President is a unique gathering today have a far-reaching effect on the development of the world.

For the first time in history leading scientists and logists from all lands whose special function is to probe the secrets of nature will be assembled together to consider how best the tremendous new discovery can be used for the benefit of mankind.

Their meeting will constitute, in effect, a sort of global brain trust for human progress.

Even from a statistical point of view, the conference is of an unprecedented character. About 1,000 of the world's most eminent scientists and technical experts together with observers and representatives from numerous non-Governmental organisations and cultural bodies, as well as 400 to 500 journalists—all a total of about 3,000—will participate in the conference in the way of another.

Within the space of 12 working days, scheduled for the conference, 40 sectional meetings and six or seven plenary sessions will be held. There are also to be public lectures as well as given by some of the most distinguished personalities in contemporary science.

The conference proceedings will take the form of discussions in the form of working groups. The

Top: Headlines from the Hindu, 13 August 1955

Right: Bhabha presiding over the United Nations' Atoms for Peace Conference, at Geneva in 1955. Dag Hammarskjöld, Secretary General of the United Nations is seen to Bhabha's right, Mr. Walter Whitman, Science Advisor to the US Secretary is seen to his left.



'The historical period we are just entering, in which atomic energy released by the fission process will supply some of the power requirements of the world, may well be regarded one day as the primitive period of the Atomic Age...

I venture to predict that a method will be found for liberating fusion energy in a controlled manner within the next two decades. When that happens, the energy problems of the world will truly have been solved for ever, for the fuel will be as plentiful as the heavy hydrogen in the oceans.'

An excerpt from Dr Bhabha's address at 1955 Geneva Conference.





A session in progress during the First U.N. Conference on Peaceful Uses of Atomic Energy held in Geneva in 1955. Homi Bhabha is seen sitting to the extreme left. The U.N. Secretary General Dag Hammarskjöld is also seen. The interpreters are seen sitting behind the stage while, typists and reporters are seen in the foreground recording details of the proceedings.

Rasipuram Krishnaswamy Iyer Laxman (b. 1924) is regarded as India's greatest cartoonist. Laxman famously created the common man who is seen here riding the bullock cart of progress with 'Atomic Wheels' looking puzzled by it all. Bhabha was fond of Laxman's cartoons and had one of them enlarged and hung in his room at home. One of Laxman's cartoons of Bhabha looking at a model of the atom appeared in *Science Today*, October 1984. The accompanying article titled 'A Universal Man' said: 'He brought to a degenerate India the sense of beauty and oneness with nature that once upon a time poets like Kalidas possessed.'

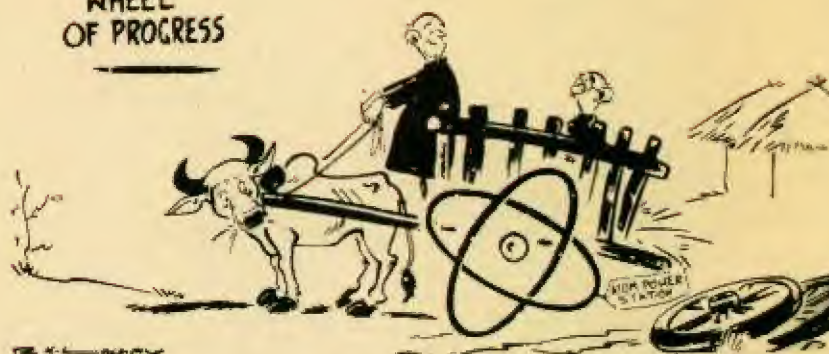
The Atomic Kingdom

Top: Nehru rides on the 'wheels of progress'.

Bottom Left: Laxman's cartoon of Bhabha, *Science Today*, 1984.

Bottom Right: Laxman's cartoon of Bhabha and Prime Minister Shastri gifted to J.J. Bhabha in 1964.

'WHEEL' OF PROGRESS





Shankar's Weekly, the Indian counterpart to *Punch* identified Bhabha as 'The Man of the Week' during the Atoms for Peace Conference in Geneva in 1955. This cartoon accompanied the piece.

The Man of the Week

One of India's greatest contributions to science, said Pandit Jawaharlal Nehru the other day, was the discovery of the cipher. He might have added that India's other great scientific contribution was the discovery of Dr Homi J. Bhabha.

The 'Raman Effect' has already become a part of pure physics and does not need any further encomium. A Bhabha Effect is yet to come. His contribution to the atoms-for-peace conference proves that when it does it will mean an improvement for the life of our people.

The modern physicist has demolished the pillars of Newtonian science and substituted an intangible world of symbols so that the universe can now be apprehended only mathematically. The layman, confounded by the elusiveness of the symbols, very often takes refuge in a pathetic trust in scientists, a trust that more often than not is unjustified.

Fortunately for Dr Bhabha, he is an Indian and he need not betray that trust through any fear of the moronism of politicians unless he has political ambitions himself. His speech at the conference is heartening because it reveals that he is a scientist first and anything else afterwards.

'Our first duty as scientists is to establish the truth and in this matter our responsibility to humanity transcends our allegiance to any State,' he said. Brave words. In the face of the State's robot-like indifference to ethics, will the scientist be able to withstand the shock of the politician's attack? If he does, he is the saviour of mankind.

This is the inescapable paradox of the present age: we can either exterminate ourselves or we can create a world in which there is no upward limit to quantitative material prosperity. The symbol for either consummation is the same - the atom.

And Dr Bhabha is our man of the week for having upheld, as India's foremost atomic scientist our determination to achieve the latter end.

By G. K. Venkatesh, 1955

B.V. Thosar (1913-1996), had a PhD in nuclear physics from Birmingham University when he joined TIFR. He set up the nuclear spectroscopy group at the Institute and had several close interactions with Homi Bhabha. This excerpt is from his autobiography, *Growing Up with Science in India*.

Atomic Kingdom

Perceiving the future important role which atomic energy is to have, he succeeded, with the full support of Pandit Nehru, in forming the Atomic Energy Commission, the Department of Atomic Energy with headquarters in Bombay and in the mid-fifties the Atomic Energy Establishment in Trombay. He headed all these

organizations. It was Bhabha's foresight, wisdom and the great regard in which he held pure scientific research to see to it that TIFR continued to be an autonomous, non-government institution, enjoying full academic freedom, restricting direct central government authority over it to the minimum. The Institute thus grew in the atmosphere of complete academic freedom, undeterred by government interference. Bhabha did emphasize, however, that the Institute should serve as a training ground for scientists, who could then be transferred to shoulder the growing responsibilities related to the Atomic Energy Programme in the country. Hence, in his opinion, the importance of developing experimental nuclear physics groups in the Institute alongside other areas of pure research like mathematics, theoretical physics and cosmic rays.

Homi Sethna joined the Atomic Energy Commission in 1949 after an MSE from the University of Michigan, Ann Arbor. He became director of BARC in 1966 and subsequently had the longest tenure as Chairman of the Atomic Energy Commission from 1972 to 1983.

The main strategy which Dr Bhabha developed as far as atomic energy is concerned is that he laid down the route... it all turned out extremely successful. Initially he had a very strong department of physics in Trombay. He then started the building of the computer in TIFR; it was called TIFRAC, and it was a success. This was followed later, which by now, is

11901

B.V. Thosar with Sir John Cockcroft at TIFR Workshop, 1961



the biggest computer centre available in Trombay. Thanks to him. He did the basic set up which one could use completely as and how one wanted.

His idea in setting up the Atomic Energy Commission was that it could have members who would express their views, but the final decision was that of the boss, the chairman and that was himself at that time; and it works successfully even now. It is a fabulous structure, which he left behind and it meets all exigencies and requirements of atomic energy so far as we are concerned, even now.

Raja Ramanna (1925-2004), had a PhD in nuclear physics from King's College London. He was one of the earliest to join Homi Bhabha first at TIFR and later at the Atomic Energy Establishment. He was a young physicist in Bhabha's team when India's first research reactor was commissioned in 1956. He was director of the Bhabha Atomic Research Centre (1972-1978 and 1981-83). He was chairman of the Atomic Energy Commission from 1984 to 1987.

IC: When you came back from London was Bhabha's Atomic Energy Programme already in place?

RR: He had made up his mind about it in the 1940s or perhaps, 1944. What he wanted exactly was a fission man. He still had to get engineers. That was the next problem. But he was brave enough to face the problem. In fact that chapter in which

Bhabha was involved is all complete now. Everything that he wanted has been done and done better.

IC: In the early days it seems to me that the Atomic Energy Establishment and TIFR seem to function together for a while at least.

RR: They were all single and at the same time the work was quite well-defined. TIFR was fundamental work. BARC involved some fundamental work but it was totally connected with nuclear power and may be nuclear explosions.

IC: But would a lot of scientists in TIFR get involved in BARC?

RR: We were there in TIFR only for about two years but I was involved with students for four or five years. Then I was completely transferred to Atomic Energy, when it was ready.

Dr Hannah Peters (1911-2009) was a medical doctor who worked in the Health Physics Group in the Atomic Energy Establishment Trombay from 1952-1959 when she came to India with husband, the cosmic ray physicist Bernard Peters and her children Tom and Susan.

Homi Bhabha was a fascinating man, a Renaissance figure. His interests hardly knew any limits. Wherever he was in the world, he studied the architecture of the cities and parks, the trees, plants and gardens of the region. He brought



Farewell function for C.F. Powell and Isobel Powell at Kenilworth. Bernard Peters (standing first row, third from left), Isobel Powell (first row, eighth from left) behind her is Cecil Powell and to his left Hannah Peters, Susan and Tom Peters kneeling in front. V.S. Vasudevachar seen on the last row, seventh from left.

Atomic Kingdom

plants from the countries he visited and tried to grow them in India. He told me that he brought the white bougainvillea from South America and planted it for the first time in India and it grew! And now it can be seen all over India. He used his botanical knowledge well when the new TIFR was being built in Colaba and the Atomic Energy Establishment was planned in Trombay. His dream was 'to create a Versailles' in Trombay, he told me.

We saw Homi Bhabha often. We lived on Pedder Road, number 53, the beautiful old bungalow which belonged to his aunt, who still lived in a part of it. He often came to our apartment at 7 in the morning to pick up my husband to drive with him to Juhu, where they walked for an hour or more and discussed physics and solved problems. These discussions were important and stimulating to both, so they said.

One of Homi Bhabha's great talents was to use the expertise of people and put them into places useful to science. So he asked me to set up the Medical Division of the Atomic Energy Department and organize

a radiation protection service. He knew that I had no experience in this field, but he knew also that putting people to a task develops their ability to solve problems!

Dr P.K. Iyengar (b. 1932), nuclear physicist and former chairman of the Indian Atomic Energy Commission, joined the Department of Atomic Energy in 1952 as a young research scientist. He became director of the Bhabha Atomic Research Centre in 1984 and subsequently, secretary to the Department of Atomic Energy and chairman of the Nuclear Power Corporation of India.

Homi Bhabha was a theoretician but he had done a mechanical engineering degree before and he was very eager to see the experimental capability being built up. Every week he would take a round of TIFR and visit every lab. He would ask what was new, what we were building. He encouraged the experimental equipment. Don't forget that one of the things that he did in the 1950s was to create the electronics production unit – which meant building electronic

equipment that was not available commercially. For example if you wanted to do a geophysical exploration to look for radio activity in land, you needed monitors, amplifiers, power supplies, multi-channel lasers, scalars – these things were built here. This was very strange because generally you would not find a research laboratory having a production unit. But Bhabha knew that without that he couldn't generate a lot more facilities.

I liked the way Bhabha treated scientists. His policy was, 'Yes, you are responsible and what I trust and give, you must pay back in terms of achievement.' And we were always considered superior to administrators. In fact the closer-association happened when he came to Chalk River in 1957. Chalk River had only one restaurant called the Honey Dew restaurant, which was not of very high quality. The next day was Sunday and the restaurants were going to be closed. Allardice said, 'I don't know where Homi will have lunch.' We said we would be very happy to cook for him at our place. We were all bachelors and so he would have to eat what we cook. So Allardice went and told Bhabha who readily agreed. But then he also said we should invite W.B. Lewis, Grey and the others. We invited all of them. We cooked some pure vegetarian South Indian style food. Everyone enjoyed it; they also carried some home for their wives. That was a very interesting day. I still remember it very well.

Satyendra Kumar Bhattacharjee (b. 1926), had applied to TIFR while doing his PhD in nuclear physics at the University of Notre Dame. He was interviewed and selected by Homi Bhabha at Chicago. He joined TIFR as a research fellow in 1954 and was involved in setting up the nuclear physics group.

When I joined, Ramanna had his group. P.K. Iyenger was actually a student at that time. There was B. Raghavan and 2 or 3 other people who were working with Ramanna. Professor Thosar was also there – he had a group of his own – the nuclear spectroscopy group. Our group came to be called the nuclear physics group.

After a couple of months they acquired the land which housed the military barracks which is the location of TIFR now. And we were allotted some rooms. The Cascade Generator had already been installed a year back in Colaba. The other hutments were an extension of that Cascade Generator hall and we were given some space there. And there we really grew, that is the history. The analyzing magnet of the Cascade Generator was made here in Bombay. We later used it as a fine charged particle machine. I was involved in changing it into a charged particle machine and ultimately it turned out to be quite a fine machine.

We concentrated on building equipment because that was really the prime motive

of our group. If we wanted to do some research, we had to build our equipment. They would provide the components and there were a few people to assist me. This is how it all started.

Dr M.R. Srinivasan (b. 1930) joined the Department of Atomic Energy in 1955 after completing his doctoral research in the field of gas turbines. He became the chairman of the Atomic Energy Commission in 1987 and also secretary to Department of Atomic Energy.

I saw Homi Bhabha for the first time in January 1951 when I was a research scholar at the Indian Institute of Science, Bangalore. Dr Bhabha was the general president of the Indian Science Congress, 1951 and he gave a very interesting talk on fundamental particles. I had no opportunity to meet him. Indeed, at that time, I had no premonition that I would be working in his organization. I finally met Homi Bhabha in January 1956. He was busy with the design and construction of India's first nuclear research reactor – Apsara or the Swimming Pool Reactor as it was then called. I was assigned the task of getting some large aluminium structures required for the reactor fabricated in a workshop in central Bombay. During 1956–57, Dr Bhabha used to have a 'briefing session' once a week when some eight to ten of us scientists and engineers would discuss the latest developments taking place in our particular area of expertise. I reported on developments in the field of reactor technology. I was struck by Bhabha's penetrating insight and broad understanding of many facets of engineering. He had a magisterial presence, and younger colleagues had to be fully prepared to put across his/

her ideas to him clearly and convincingly. Bhabha's mind worked so fast that much before the idea was fully explained, he would pose many questions that went beyond what had been presented. But once the younger colleague was able to stand his ground and present the case convincingly, Bhabha was very appreciative and generous in acknowledging the effort.

In my view the most important contribution of Bhabha was instilling self confidence among all those who worked with him. He liberated them from their perceived sense of inadequacy and prodded them to think along new and original lines to solve the assigned problem. Bhabha had immense confidence in the ability of his young colleagues and inspired them with his own enormous self confidence.

C.V.K. Baba (1937-2006) belonged to the first batch of the Department of Atomic Energy Training School and joined TIFR right afterwards in 1958. He later moved to BARC and helped start an accelerator-based nuclear spectroscopy programme. Known as an experimentalist who thought up simple technological solutions, he collaborated on high energy gamma ray experiments at VECC, Kolkata, at the Pelletron at TIFR and at the Nuclear Science Centre in Delhi.

I gave a colloquium in 1961. At that time, we were in the Old Yacht Club. There was a lecture hall located on the ground floor. Bhabha was there for the colloquium. Then one day he came to the lab. At that time there was air conditioning, but it did not run for twenty-four hours – it was shut off at 9.30-10 o'clock at night. But we were running experiments, and we had a lot of electronic equipment that would get very hot. By the time we



The war-time huts at Colaba where scientific work was carried out before the new building came up.

returned in the morning, naturally the electronic equipment would not behave properly. I had complained many times to the engineer, but they said that they had to close off the air conditioning at night. Once Bhabha came to our lab and asked us whether everything was alright. I told him, 'Sir, at night there is no air conditioning. I have automated these instruments, and it is printing data. At night, air conditioning *hota to achcha hota*.' Then he immediately told Lazarus, the engineer, 'Please see that this wing has air conditioning at night.' He saw the instruments running and he thought that it was only proper to make this request.

When Niels Bohr came for a visit to TIFR, Bhabha brought him to see our lab. I think it was in 1960, before I went abroad. Bhabha brought him to see my experiments. He came here and looked at the experiments and even asked me a question. It was slightly theory-oriented question and I could answer that and that made me happy.

Anil Kakodkar, nuclear physicist, joined the Department of Atomic Energy in 1964 as a young research scientist.

He became director of the Bhabha Atomic Research Centre in 1996 and later chairman of the Indian Atomic Energy Commission and secretary to the Department of Atomic Energy (2000-2009).

The two odd years between my joining BARC [AEET at that time] and Dr Bhabha's untimely demise did not afford much opportunity for me to know him first hand. Dr Bhabha did visit the training school during our time. All of us, as trainees, were anxious about the kind of assignments we would have. In our limited perception then, we found ourselves to be too many to be added in one year. We once actually posed this question to him. He seemed quite clear. He felt, 'It is important that there is a pool of relevant expertise available for meeting the requirements as they emerge.' He also mentioned that he did expect many of us to move to Universities after some years of research experience in DAE. Indeed, he had clear and practical ideas about the importance of human resource development and the linkages with Universities.

At Trombay, we could see Dr Bhabha visit the construction site of Modular Laboratories very frequently. In fact, I have seen him and heard several stories about the great care he took in deciding on the pattern of grills to be installed along the length of Modular Labs, and the design of spray nozzles for the spray ponds in front of CIRUS (then CIR). In fact the blueprint of layout in Trombay was chalked out by him with great care and remained a very useful guide for several decades to follow.

Dr Bhabha, for us, was an icon with several tales doing the rounds about

his authority in shaping a very conducive and caring environment for doing good science that brings benefits to science as well as to society.

N.B. Prasad joined the Atomic Energy Establishment in 1954, and later became a Project Manager (India) for the Canada-India Reactor. He was the chairman of the ONGC.

I had the honour of co-authoring a paper with Dr Bhabha for a presentation at the Second International Conference at Geneva on Atomic Energy. The paper was entitled 'A Study of the contribution of Atomic Energy to a power programme in India' and articulated for the first time a three step programme involving thorium breeders. In a short span of seven years, Dr Bhabha was able to accomplish the whole nuclear energy cycle, beginning with the mining of uranium and ending with separation of plutonium in spite of an inadequate supply of highly qualified scientific and engineering manpower in the country.

Looking back it seems he was picking up pieces to place into a jigsaw puzzle he had in mind, and expected each one of us to play our part to fill the puzzle. For me, as probably for others, it was

more of an education rather than a job as he proved to be a great mentor of young minds and helped them to grow to the limits of their capabilities. He was a wise and compassionate leader with a great sense of regard for people working with him. I travelled with him often and wherever we went, he would take me with him to the museums – in Paris, Leningrad – and he'd say 'Prasad, let's go!' By association, over the years, one could imbibe the value system from him.

I was the project manager when CIRUS was being built. The Canadians were proposing a plastic cover for the dome, but I said that we could cover the dome with aluminium and he supported me. It is still standing and still shining!

He was present when I read a paper on the Swimming Pool Reactor, *Apsara* at the Science Congress held in Agra, in 1956. Later he was scheduled to have tea with the Prime Minister at the Circuit House. He suggested that I should go there with him. Graciously he asked me not only to join them for tea but also for the discussions. Similarly, when the Queen of England visited Bombay and he hosted a private dinner for her at his residence, he chose to invite only his professional colleagues and not the wealthy and the powerful of Bombay.



9. HOMI'S OTHER WORLD

'I know clearly what I want out of life. Life and my emotions are the only things I am conscious of. I love the consciousness of life and I want as much of it as I can get. But the span of one's life is limited. What comes after death no one knows. Nor do I care. Since, therefore, I cannot increase the content of life by increasing its duration, I will increase it by increasing its intensity. Art, music, poetry and everything else that I do have this one purpose – increasing the intensity of my consciousness of life.'

Homi Bhabha, letter to Jessie Maver, 1934.

In his youth, Homi had nurtured for a while a passionate desire to become a painter – an aspiration that was bridled only by his doubts about whether he could sustain a life in art once he returned to India. But he continued to sketch informal portraits and not infrequently, doodled as he listened to speeches during meetings. Homi's masterly sketches thrilled his subjects.

Soon after he returned to India, Homi found himself in a different circle. The war had brought to Bombay eminent Jewish artists such as Walter Langhammer and Magda Nachman as well as the art critic Rudi von Leyden. Exiled from Europe, they became part of Bombay's lively cultural community. Homi became their friend. Some years later, when the Progressive Artists Group started in Bombay, Homi fashioned for himself the role of patron and prime supporter – he immersed himself in long discussions about aesthetics with the young artist-rebels and slowly began to adorn his Institute with their works. In this he was rarely alone – his friend and companion, Phiroza 'Pipsy' Wadia, an art connoisseur herself, was often involved in the selection of the art work – as were his colleagues, the mathematician K. Chandrasekharan and later, the physicist, M.G.K. Menon. The TIFR art collection remains till today,



The Amoeba Garden at TIFR became a legend in Bhabha's lifetime. It is said that he personally supervised this particular landscape feature by observing it from his office on the fourth floor of the Institute. The Amoeba Garden changed shape until Bhabha was satisfied.

the largest single collection of the Bombay Progressive Artists. Moving beyond contemporary art at home, Homi also brought into his Institute extraordinary and exquisite paradigms of contemporary European art. In 1954 he appalled cautious and conformist sensibilities by purchasing for his Institute a head of Einstein by the renowned sculptor Joseph Epstein.

Apart from art, music remained his other passion. The coming of the long-playing record and the electric record-player perhaps ensured that he could listen to his favourite classical composers without disruption. But he also took every opportunity to visit Vienna in the festival season – reserving in advance specific concerts he wished to listen to. At his Institute, Homi had planned the auditorium as a place of recreation and pleasure for those who worked at the Institute and those who visited it.

Recollecting Homi's artistic bent of mind, J.R.D. Tata had once said 'whatever he built had to be beautiful and had to have gardens'. At the Tata Institute of Fundamental Research and at the Atomic Energy Establishment, Trombay, Bhabha created gardens of breath-taking beauty which would refresh the spirit and awaken the delight of those

who had spent the day working inside the laboratories. Bhabha along with S.D. Vaidya – who was in charge of Parks and Gardens at TIFR and AEET – modified a 'French' model for the gardens at TIFR and AEET, adapting the patterns and geometrical trends of the gardens at Versailles. Together they dreamt of creating an 'industrial Versailles' at Trombay. Yet even within that alien scheme, the global was modified and made to accommodate the local – many a tree was spared the axe and transplanted in a suitable location in the garden – a practice that Homi introduced for the first time in India. His extraordinary interest in plants led him to collect plants from all over India – indeed, from all over the world – from Calcutta, Delhi, Bangalore – from Australia, America, Mexico and Europe.

Homi's
Other World

And so it was that Homi Bhabha – scientist and institution-builder extraordinaire – held together the twin worlds of nature and culture, nurtured them and made them vibrant.



12021

Top, left to right: Sketches done at Cambridge, c. 1920s. Portrait of Sir Lawrence Bragg by Homi Bhabha and Hugh Carmichael which is still kept at the Cavendish.
Facing page: An abstract composition done at Cambridge

WABHINDRANATH TAGORE'S EXPRESSIONIST WORKS ARE EXHIBITED IN EUROPE | AMRITA SHEKHAR RETURNS TO INDIA FROM PARIS

1951 | ALAM ARA FIRST INDIAN TALKIE FILM RELEASED | SALVADOR DALI, THE PERSISTENCE OF MEMORY



While a student in Cambridge, he drew and painted from models whenever he found time. He painted in a romantic symbolist style and experimented intensively in abstract visual interpretations of musical themes, based, as they were, on his knowledge of the mathematical structure of music.

Rudi van Leyden, 'Homi Bhabha as Artist', *Marg*, 1953.

While at Cambridge, Bhabha had met the eminent art critic Roger Fry, Slade Professor of Fine Arts, and shown him his sketches. Writing about one of his meetings with Fry in 1931, Bhabha wrote to his friend Homi Seervai: 'He felt I had very extraordinary talent and that my powers would be best expressed in works on a larger scale. He said he would like to see me try fresco, say at New Delhi.' This powerful sketch belongs to 1931 and was done some months after his meeting with Fry.

Homi's
Other World

12041

Sketch done by Homi
Bhabha while at
Cambridge, 1931





This is the first letter I ever received from Homi - 1933 - It's written on air mail paper - in pencil - & I can hardly make some of it out - I hope you can. The xerox isn't too good - or too bad either. But this gives such a picture of him - at 23! So please struggle with it! I love this letter! The Colonel (on page 3) is this imaginary 'British Army in India & all that' Colonel - who would keep interrupting our conversation! How I loved all that nonsense! And the comment about the spark & the fire - (page 7) - I have never forgotten that! JM

DA (IV) 33 HOMI TO JESSIE

My dear Jessie,

At last I have found a restaurant that's even moderately good. A party of English and American 'young men' just nearby is indulging in a string of obscenities. They aren't even funny, merely trivial and sordid. I am writing just after lunch and was at Cook's just before. When I went to Cook's this morning, the man told me there was no mail, and I went to the Gallery thinking of you. 'Has this woman been merely playing with me too? Nevertheless it was nice to have met her' And there, here is your letter, a charming letter, something that's genuine. There is only one other woman I know who could write such an interesting letter, and that is this friend who is going to marry this friend of mine in Africa.

Homi's
Other World

That night I went to the Peter's Keller again ate in the Grand it was empty, that room where we usually sat at night. I was the only person there. You know that monk who superintends the place and walks around bowing to people. When he came to me I told him that one dined very well there, that the wines were superb. We talked about various things for quite a time. I offered him a seat. I told him that a taste in food had some connection with a developed plastic sense. (Sooner, said I could a camel pass through a needle's eye than barrock or Mozart be produced in Prussia.) After some minutes he left me. When later I got up to go, the fat white haired waiter ran out of the room as if he was being chased by a mad bull. Presently, appeared the said monk, who shook me by the hand, said he was glad I was satisfied with the food, and hoped to see us again in Salzburg. One can't describe a scene like that but you can imagine it.

I also spent some time in the Mozarteum, reading letters of Mozart. He who does not know these letters does not know Mozart. They are charming, bubbling with humour and the goodness of his nature. And all that utterly bad verse he used to throw off - it's so delicious, one degree more imbecile than the Colonel! - and he was perhaps the greatest artist that lived - that in Music he is only rivalled by Bach or Beethoven is without doubt. And Beethoven never equalled the best Mozart until the works of his last period, particularly the late quartets and sonatas, and they are just the Beethoven that is unknown to the public. Just as well, they wouldn't understand it. And this naturalness of Mozart is one whole better than the behaviour of that fat and sensual swine Wagner with his mutton chop whiskers, and that bloated pig Brahms, with his flowing beard - who was disgusting enough to eat a tin of sardines and then pour the oil down his throat.

12061

Vienna is dead. There is life only on the surface. Everything is drab. There is no money. Practically everything one finds today is 'cheap'. It will only become still cheaper and drabber. The dust will accumulate on the cupboard top. If it goes on like this, in a century or two, a more bumptious and uneducated nation will conquer them. And this was the city that produced Haydn, Mozart, Beethoven and Schubert almost so that these four could have met together. This is roughly how Greece and India degenerated. And yet, walking about the streets of Vienna, when I suddenly see a picture of Schubert with his side whiskers and thick hornrimmed spectacles, I feel so at home. He was obviously such a

Bhabha met Jessie Maver in Vienna in 1933. He was travelling in Europe at the time. They remained friends for over three decades sharing their love for music. This letter was sent by Mrs Maver to his family after Bhabha's death along with a note explaining the fictitious 'Colonel'.

genial companion. And a man who wrote mature music at 20. Even Mozart did not do that.

I am feeling so happy today going down the Danube. The weather is fine. The people are congenial. This sort of weather always reminds me of Van Gogh. I am resting from 2 hectic days in Vienna. There is lots of fine barrock in Vienna we could have seen together.

By the way I read your last letter before writing last, that comes of being logical. The pages weren't numbered so I decided that the first page would be the one that bore the date and address and started there, and read your aforementioned slip.

If you go to Flórence, one eats really well at this restaurant the name of which I have forgotten... it has a small boy in a red uniform standing just inside the door usually. If you go to Milan go to the Brera Gallery. You must see a picture by El Greco there. It is the best. A man, a saint, kneeling in a high state of emotion with another large figure turning his back to the spectator. It is a superb work - look at it from far and close. The exquisite painting of the face and the dress makes even early Raphael appear gross in his handling. Greco had such a superbly refined sensibility. Observe the subtle relations of volumes, my deah.

Darling, I could go on writing to you for ever. I have so much to say, but I haven't the time. Is it quite certain that you must sail on the 25th? If so could you manage to be in London till the end, so we could meet there? I shall come to London on 22nd or so. But couldn't you sail a month later, or even a couple. We could meet in Paris or in Rome. If there is no hurry, and money is not concerned, why don't you stay. There is lots to see in Europe. I could show you and explain to you such a lot. Do consider this seriously, and write to me always by air while you are in Europe. Besides you could live comfortably much cheaper than you are doing now.

The other day in a restaurant, I saw a wine cask - the barrel of which was not circular but elliptic - my deah, too barrock!

By the way you thanked me for giving you a spark. But a fire (if I can say fire to compare myself to one) throws off sparks. One has not to thank it for that. It is only glad when it finds something it can set alight. Most people have such damp souls that the fires of Hell could not make them burn. They would merely emit grey and disgusting smoke.

Write to me c/o Cooks Vienna till Monday next. After that to Cook's Copenhagen if there is one. If not to London (not Cambridge) - you have the address.

Yours,

Homi Bhabha

Sir Julian Sorell Huxley (1887-1975), FRS, evolutionary biologist and the first director-general of UNESCO (1946-1948), wrote to Bhabha requesting him to consider the post of director-general of UNESCO. This is an excerpt from his letter.

15.02.53 HUXLEY TO BHABHA

31 Pond Street | Hampstead | London NW3

Homi's
Other World

My dear Bhabha,

We all miss you here at the Commission, but quite understood your being too undertaken up with your huge scientific job to be able to attend. You will be glad to hear that this meeting of the Bureau has been very constructive and after being much discouraged last year, I now feel more than ever confident that we can and will produce an important and indeed unique work, which could not have been produced except by a highly organized team working under the auspices of an international body and with the collaboration of historians from all over the world.

However, this is not what I want to write about. My real motive concerns the Director-Generalship of UNESCO – all sorts of rumours (as well as a few facts!) are circulating here as to candidates for the post, and one of them is that you were a possible candidate but that there were difficulties about leaving your scientific work. I don't know in the least what the truth is, but felt you would pardon my writing, entirely personally (I have no personal connection with UNESCO, or with the British delegation), on the matter.

What I feel, my dear Bhabha, is this – that the actual candidates for the post are all second rate, or unacceptable for other reasons – (one is Errera from Belgium [!]; another maybe Dutering of Sweden, a Greek scholar whose only idea is to cut the budget by 25%! And Malik of the Lebanon...) Is there no chance of your being put forward by the Government of India? (a) It is rather important that the new DG should be an Asian – we have had a European and a Latin American, (and US is excluded) and it is due to the East to fill this post. (There is of course the Middle-East – but frankly there are no names of sufficient standing from there). (b) And more important – you are, if I may say so, eminently indicated for the post – an eminent scientist, with experience of administration, an artist, with a great knowledge and appreciation of the arts, and at home with both the East and the West. One great danger is that the Executive Board and the Conference will plumb for 'safety' and elect a second-rate administrator or politician. And UNESCO is really too important to be put into such hands.

I know extremely well how important it is that science should be properly organised in India – but have you not got it to a pitch where you could leave it, in favour of a few years in the even larger world of the World? I have no idea of what could be in the minds of the Executive Board members – but my impression is that if your name were put forward by your government it would be – to put it negatively!

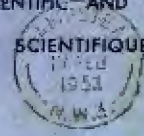
12081



From J.S. Huxley 31 Pond St London NW3

INTERNATIONAL COMMISSION FOR A SCIENTIFIC AND CULTURAL
COMMISSION INTERNATIONALE POUR UNE HISTOIRE SCIENTIFIQUE ET CULTURELLE

Personal



- extremely difficult for them to select any one else. (If time were an issue, I should imagine that your name could be put forward saying that the Government of India would find it very difficult to spare you for the full term of 6 years - but I would not suggest how precisely the suggestion of a shorter term might be best formulated - only that it might be useful).

May I finish by repeating that this is a purely personal letter - I shall not tell anyone, inside or outside UNESCO, that I have written it. But I do believe so much in UNESCO that I have felt I must write.

On quite another matter, I have accepted an invitation to lecture in Australia this autumn, and like very much to be able to break my return journey in India - which I have never seen! I am most anxious to see other things besides science in India - your great cities, caves of Ellora and Ajanta, something of the ancient Indus civilization, something of Indian wildlife and natural history. And I should like to be able to arrange for my wife to join me in India, if it were possible to arrange that hospitality would be extended to her during my stay in your country.

I have just published a little book on Evolution, of which I will send you a copy - I think you will be interested.

Julliette joins me in best regards - it is much too long since we have seen each other!

Yours very sincerely,

Julian Huxley.

In 1947 an ambitious exhibition of Indian art was put together to be displayed in London the following year. The selection committee rejected the works of Magda Nachman Acharya, a Russian painter in exile in Bombay. Taking up her case, Bhabha wrote to Maulana Azad, the minister of education. He argued that it was time for India to take a more expansive view of who was an Indian painter. (This is an excerpt from Bhabha's letter.)

24.07.47 BHABHA TO MAULANA AZAD

My dear Maulana Saheb,

I enclose herewith a letter I have received from Mr M.P.T. Acharya of Bombay with the copy of a letter regarding his wife Magda Nachman Acharya which he addressed to a certain Mr K. Gandhi. A copy of this letter had been sent to me through a friend while I was in Simla, and I showed it to you then. I assumed at the time that it had been addressed to Gandhiji but I find now that it was addressed to Mr Gandhi the Bombay art dealer who is interested in rising modern artists.

Homi's
Other World

This matter has arisen in connection with the Exhibition of Indian Art to be held in London. I am, of course, writing to Mrs Naidu as the chairman of the All-India Committee dealing with this Exhibition, but the reasons which weighed with some members of the local committee when Mrs Nachman Acharya's pictures were under consideration raises a matter of principle which will have results reaching far beyond this particular Exhibition. It is for this reason that I am bringing it to your notice in your capacity of Education Member of the present government, in whose domain all cultural matters fall, so that you may make it the occasion for announcing the policy of our government on the principle involved, for the future guidance of official and semi-official bodies.

As Mr Acharya points out, his wife has been married to him for over 25 years and has lived continuously in this country for twelve years. She has, therefore, acquired Indian nationality and domicile by virtue of her marriage, and, as such, enjoys the same rights and privileges under the Indian law as any other Indian national.

The point which was raised by my friend Mr Karl Khandalawala, who is the chairman of the local committee for the selection of pictures from Bombay province for the modern section of this Exhibition, of which committee I am also a member, in that apart from any legal aspects of the matter, Mrs Acharya was born and trained in Europe and that as such her work has no place in an Exhibition of Indian art. The contention is not that she paints in European style, for at least half a dozen of the pictures chosen by the committee are painted in purely European styles, and practically all the others show the unmistakable influence of European art.

12101

There can be no doubt about the technical competence and artistic merit of the best of Mrs Nachman Acharya's work. She held a 'one-man' show at the Chetana galleries in Bombay in February this year which was opened by the Hon'ble Mr Justice M.C. Chagla. I enclose a cutting from *Bharat Jyoti* which reproduces three photographs of her work. The picture on the right entitled Bharata Natyam is actually a painting of the Indian dancer Shrimati Shanta Rao in a Bharata Natyam pose. The book on 'Dance in India' by the well-known art critic and writer G. Venkatachalam has this picture in colour on the cover.

It seems to me that the purpose of the modern section of the Indian exhibition in London is to give the world a picture of the achievements and cultural life of modern Indian society in the sphere of the plastic arts, and in particular painting. This cultural life is not made up only by the work of Indian artists; artists of foreign origin domiciled in India also make their contribution to it. To exclude Mrs Nachman

Acharya's work from this Exhibition on the ground that she was born abroad would be like sending Uday Shankar's troupe abroad to a dance festival and insisting on the omission of Simkie, who was his chief dancing partner on the ground that she is French. It should also be remembered that one of our best modern artists, Amrita Shergill, was of half Hungarian descent and received her entire artistic training in Paris. The point of view I take is the one taken in all progressive countries. For example, pictures of Picasso are included in official exhibitions of modern French painting although he is avowedly a Spaniard. Indeed, among the modern French school are included the paintings not only of French artists but of those of many different nationalities, such as for example the Flemish painters Van Dongen and Vlaminck who simply live in Paris and form part of the artistic life of that city. The position in America is exactly the same and the United States has consistently followed the most liberal policy in cultural and scientific matters despite the fact that its immigration laws in other respects are extremely rigorous. To give but one example, Americans proudly claim as their own, Arthur Cohnstiel 'the distinguished American artist of Austrian origin', although he has hardly lived a decade in America. The great strides in science and the arts that the United States has made in the last twenty years are entirely due to this liberal and far-sighted policy.

Art like Science knows no frontiers and we should not only not put any impediments in the way of foreign artists coming to this country but should rather encourage them to do so provided they are people of eminence and have a contribution to make to our cultural and intellectual life. We all hope that with its newly achieved freedom, India will become the leading country of Asia and one of the leaders of the world in cultural matters. In order that this should be possible all streams of artistic expression must be allowed to flow freely in India in order that her artists should express the life of modern India which is socially and economically based upon modern science and technology.

It is an injustice that considerations about her origin should have influenced the decision not to choose Mrs Magda Acharya's pictures for the Indian exhibition in London and it would become a bad precedent for the future if it were allowed to pass without some appropriate action being taken. Indeed, it seems to me that some action is absolutely necessary in view of the fact that this is not a private exhibition, but one with which the Government of India is associated. I trust you will make some statement which will lay down the policy of our national government on such questions for the future guidance of official and semi-official bodies, and establish a valuable principle in line with the broad ideals for which the Congress has always fought.

May I take this opportunity of saying how stimulating I found our conversations in Simla, and what pleasure it was to have had the privilege of getting to know you.

With kind regards.

Yours sincerely,

Homi J. Bhabha

On 29 April 1952 the Royal Asiatic Society Bombay commemorated the 500th birthday of Leonardo da Vinci. Homi Bhabha was asked to say a few words about Leonardo the scientist. As he was travelling at the time his speech was read out by Dr George Moraes.

Leonardo was undoubtedly the greatest draughtsman of the Italian Renaissance, he not only had phenomenal powers of observation, but a hand which could put down, seemingly effortlessly, whatever he wanted to. His best drawings have a precision and swiftness of line and a sensitiveness which was unequalled by any of his great contemporaries, and has probably hardly been equalled in any age. And so, even his botanical and anatomical studies, or his records of the flow of water usually have the aesthetic quality of the finest drawing.

Leonardo believed that in order to paint a thing well one should understand its structure and its operation. Thus, in order to paint figures properly, a painter should know anatomy. But the representation of human forms was not an end in itself. 'That figure is most laudable which by its action best expresses the passion which animates it.' The body is motivated by the mind which expresses itself through it, and so the painter who would express the character and state of mind of his subject must do so by portraying the correct type of face and figure with the appropriate action. One sees all these principles put into practice with consummate mastery in the Last Supper. And so he advises the painter to 'go about, and constantly, as you go, observe, and consider the habits and the behaviour of men in talking, quarrelling, laughing or fighting. The actions of the men themselves and the actions of the bystanders, who separate them or who look on. And note these with brief strokes in your little book which you should always carry with you...' His note books are full of observations accompanied by small sketches of how men perform all sorts of different actions, as for example, how a man climbs a ladder, or how he gets up from sitting on a flat piece of ground. It is this constant study of the actions of men and the psychological states motivating them, carried through with his astounding power of observation that makes the figures not only in his great compositions but also in his slightest sketches so intensely alive and real.

Leonardo's love and feeling for all living things was proverbial. We are told that he would go to the market place to buy caged birds and let them escape from his hand into freedom one by one. 'To preserve the chief gift of Nature, which is liberty...' runs a passage in one of his notebooks. This gentleness and regard for life finds interesting confirmation in a letter written by a certain Andrea Corsali to Giuliano de Medici in 1515 from 'the Indies', in which he refers to a community 'so gentle that they do not feed on anything which has blood, nor will they allow anyone to hurt any living thing, like our Leonardo da Vinci'. Although a good part of his time was occupied as a military engineer, he regarded war as 'bestialissima pazzia' – the most beastly madness. He felt that the indiscriminate destruction of people was wrong. In a remarkably prophetic passage describing some of his inventions for staying under water he writes:

'How many may stay under water by a certain machine, and how and why I do not describe my method of staying under water, and how long I can stay without eating, because of the evil nature of men, who would use them for assassinations at the bottom of the sea by breaking the bottoms of ships and sinking them together with the men in them. Nevertheless I shall treat other methods which are not dangerous, since the mouth of the tubes through which they breathe appears above the water, supported on skins and cork.'

Those who are concerned today with inventing new methods of mass destruction may well ponder upon these words.

An excerpt from: H.J. Bhabha, 'Leonardo da Vinci: 500 years', *Marg*, Vol. V: 4, 1952.

Mulk Raj Anand (1905–2004), novelist, was editor of *Marg*. Anand published Bhabha's talk on Leonardo in *Marg*. But the editor and the scientist argued about the cover of the issue. Anand was in favour of a bold Kalighat painting. Bhabha argued that by reproducing a Leonardo drawing on the cover, *Marg* will 'raise the prestige of India's artists and art lovers in the world'. Finally, *Marg* carried a drawing by Leonardo on the cover.

MARG



LEONARDO DA VINCI
QUINCENTENARY

The art critic, Rudi von Leyden had come from Vienna to India soon after the Nazi occupation. He, along with Walter Langhammer, encouraged the young artists of the Progressive Art Movement in Bombay. In 1953 he wrote an essay on Bhabha's drawings for *Marg*. Bhabha was very involved with the layout and supervised the blocks with his drawings.

Homi's
Other World

'Dr Bhabha's style is best described by "judicious and learned naturalism" in which the usual maligned term "naturalism" is meant to convey an understanding and mastering of nature and not its servile imitation. This naturalism has romantic overtones caused by the artist's personal attitude to his subject. What makes his drawings so appealing is that his personal attitude is one of modesty and humility, a kind of wooing of his subject, a penetrating struggle to understand and reveal. And thus we find that the work of this man, whose mind can visualize the working of the Cosmos in the austerity of a mathematical equation, is flooded with a gentle and tender humanity.'

[0 1 6]

Rudi von Leyden, 'The Drawings of Homi Bhabha', *Marg*, 1953.



- From Top Left (clockwise):**
- Angel's Concert, Homage to Mozart
 - Landscape with Bridge, Cambridge c. 1920
 - Sketch of Pipsy Wadia, 1943
 - Sketch of Reclining Figure, 1940
 - Sketch of Sher Gill, Simla 1947
 - Landscape study done at Cambridge

Bhabha attended the 8th Solvay Conference on Elementary Particles at Brussels in 1948. Bhabha's doodles of the eminent scientists who attended included J.R. Oppenheimer, R.E. Peierls, F.W. Pauli, E. Schrödinger, Niels Bohr and P.M.S. Blackett.



12161



Richardson



'Bhabha is a perfect example of the opposite of what C.P. Snow refers to as the alienation of scientists and humanists. He represented the best in the modern educated world, the best of science, of the arts. Bhabha not only understood the language of modern science but was thrilled with a recital of Bharata Natyam or a beautiful bronze from a temple.'

Vikram Sarabhai, speech at the condolence meeting for Dr H.J. Bhabha at AEET, Trombay, 25 January 1966.

Bhabha's letters to his scientist friends embraced a variety of subjects. He shared with the Nobel Laureate Felix Bloch (1905-1983) a love for gardening and music. The Blochs sent him begonia bulbs more than once and he in turn introduced them to the Menuhins.

21.09.52 BLOCH TO BHABHA

Dear Bhabha,

It was good to have your last letter and to hear that the tubers finally reached their destination; I hope you will have a fine bed of begonias next year!

Homi's
Other World

I want to thank you for having arranged my meeting Yehudi and Dinah Menuhin. Shortly after I wrote to him I received an invitation to his home in Los Gatos and my wife and I spent a most charming evening with them – quite 'en famille'. It was most interesting to hear him talk about India; he was evidently very much impressed by your country and expressed himself both with warm human feelings and with intelligence. I have met this same combination with Emmanuel Feuermann – the only musician of his order of magnitude whom I had the good fortune to know – and besides with some, although by no means all, of the outstanding physicists, proving once more the essential affinity between music and physics. Based upon this affinity I invited him to visit my laboratory and it was indeed remarkable to observe his boyish enthusiasm and, at the same time, his keen interest and quick understanding when we demonstrated to him some of our equipment. Dinah who also insisted to be taken along took it in a more humorous and feminine way! He is now on a concert tour in Europe and we certainly hope to see more of the Menuhins when they come back.

Dharmatti left last week for India. He will visit a number of laboratories in this country and in Europe on his way and I was glad to supply him with letters of introduction which I hope will be of some help to him in making these visits profitable. During the two years which he spent here I came to like and appreciate him more and more and I should have been very sorry to see him leave if it had not been for the feeling that he may fruitfully continue the work which he has started here in your Institute. We agreed that he will write to me when his apparatus approaches completion; this will inevitably take considerable time and the problems which seem most interesting now may not be the most interesting ones by then. I shall be happy, in any event, to inform him of what has happened here in the meantime and to advise him so that his work will avoid duplicating the efforts of others.

(218)

With best regards,

Yours sincerely

Felix Bloch

J.D. Bernal (1901-1971), also called 'the sage', was a crystallographer and one of the founders of modern biology. Referring to a previously held conversation about Picasso doing a mural for the Institute, Bhabha wrote to Bernal: 'We talked about the possibility of interesting Picasso in this.' Bernal's flat at Birbeck College had a mural by Picasso. This was the only mural that Picasso executed in England. There are no records of a reply from Bernal.

21.11.62 BHABHA TO BERNAL

My dear Bernal,

I spoke to you about a wall in the entrance hall of the new building of the Tata Institute of Fundamental Research, which is 9 ft high and 45 ft long, which we intend to cover with a mural. We talked about the possibility of interesting Picasso in this on some special terms. As I explained to you then – a situation which has become even more pronounced now as a result of our conflict with the Chinese – it is quite impossible for us to pay anything in foreign exchange, leave aside the type of price which would be appropriate for Picasso. However, I did suggest that we could pay him a first class return airfare to India and a month's stay at our expense, together with arrangements for visiting and seeing some of the famous archeological monuments in India, such as, Elephanta, Ellora and Ajanta, Khajuraho, Halebid and Belur, and the Moghul architecture in Delhi and Agra. You were to enquire of him whether he would be interested, and to let me know. I wonder if you have had any success.

With best wishes,

Yours sincerely,

Homi Bhabha

Jamini Roy (1887-1972), painter, developed a new style of painting that was simple in its use of colour and lines. In his letter to Jamini Roy, Bhabha expressed his admiration for Roy's pioneering and original contributions to contemporary Indian painting and called him 'the doyen of contemporary artists in India'. Jamini Roy responded immediately and sent his design 'Krishna Balaram' in 1963.

19.10.62 BHABHA TO JAMINI ROY

Dear Shri Jamini Roy,

The new buildings of the Tata Institute of Fundamental Research at Colaba, designed by a well-known American architect, were inaugurated by the Prime Minister on the 15th of January this year. The large entrance hall is two floors in height, and has a balcony at mezzanine level with a plain wall approximately 46 feet long and 9 feet in height. This wall is in a very prominent position, and can be seen not only from most positions in the entrance hall, but also from outside the building through the glass curtain wall. The Institute authorities have accordingly decided to cover this wall with a mural as a tribute to Indian art, and in order to encourage in our day the art of mural painting of which past ages in India have left such glorious examples. It is not of course our intention that the mural should be in any ancient style, and it could be entirely contemporary, reflecting the aesthetic trends, problems and aspirations of our day.

2. Apart from making a public announcement inviting preliminary designs 9 feet 8 inches and 2 feet high from any artist in India, who would like to send one, the Institute has also decided to invite a very few distinguished contemporary artists to submit a sketch of the size mentioned above, for which each will be paid an honorarium of Rs 800. The artist who submits the selected design will be asked to paint the mural on canvas or some other removable medium, and not directly on the wall, and the Institute has set aside a sum of Rs 15,000 to cover the honorarium to be paid to the artist, in addition to the cost of the materials.

3. In view of the eminent position you occupy among the artists of today and the fact that you are so to speak the doyen of contemporary artists in India, we are particularly keen to have from you a design 9 feet-8 inches long and 2 feet high for the mural in any medium in which you may like to execute it. It is clearly understood that your design will not be considered for competition with the rest, but as a work of art which we would treasure as part of the art collection of the Institute. I may mention in this connection that the Institute has one of the best collections of contemporary Indian art in the country, and the absence of any painting by you is a serious lacuna which we wish to fill. We would be happy to pay you an honorarium of Rs 1,000 for the design or painting requested above.

4. If, as I hope, you are willing to send us a design or painting of the above dimensions, I would be happy if you could do so before the 15th of January 1963. I am sending you herewith a blue-print showing the elevation of the south side of the entrance hall which contains the wall on which the mural is to be executed, so that you may have an idea of how the mural will be placed in relation to the building. The second blue-print gives the precise dimensions of the wall.

5. May I take this opportunity to express to you my admiration for your pioneering and original contributions to contemporary Indian painting, and I would like to call on you when I next visit Calcutta.

Yours sincerely,

H.J. Bhabha

Detail from Jamini Roy's
'Krishna Balaram' 1963
TIFR Collection



16.12.62 JAMINI ROY TO BHABHA

18, Dehi Serampore Lane,
Calcutta - 19.

16th December 1962.

Dear Dr. Bhabha,

I have just now received your letter and
am too glad for it.

Although the time left is short still I would
surely try to send the sketch by the end of December 1962
and the full size painting by the 1st week of January.
I am giving a deep thought over this matter.

you are pioneering in Scientific researches and
I on my part throughout my life researching in Art so
I would be really glad to have my painting on the
walls of the Research Institute. Apart from this I feel
the relation between you, Tata House and me is a
very deep one.

I am really very happy for your letter
and particularly for the spirit with which it has been
written.

Hope you are in excellent health.

With very best wishes,

Yours Sincerely,
Jamini Roy.

7/10/62

Mulk Raj Anand wrote a moving tribute to Bhabha that emphasized not only the close bonds they had forged in Cambridge but also Bhabha's involvement with the world of art and literature.

IN MEMORIAM: HOMI BHABHA

My dear Homi,

I wrote a letter to you as from the Lalit Kala Akademi three days before the news on the radio about the loss of 'Kanchenjanga', with you in it, came through from New Delhi. That letter, in which I had asked for advice and help from you in your capacity as the Chairman of the Reviewing Committee of the three Akademies, has remained unposted. And I am constrained to put down my own feelings about your passing away and the emotions which have possessed those of our generation who knew you intimately as the author of some of the most brilliant initiatives in the single realm of science and art in our country. The tragic fact that you will no longer be there to release the creative energies in our society can only be accepted if I recall to people's minds the various potentialities which you explored and the different areas of life which you enlivened with the touch of your genius.

I first met you in Cambridge when you were just finishing your researches. Already, the legend of your many-sided gifts had spread and I knew that you were as much interested in music, in painting, in social thought, in politics, as in science. I believe that you were one of the few scientists of our country, who was elected to the fellowship of Royal Society, but you were also one of the youngest such men in the world. Our common friend, J.D. Bernal, [also a genius of our time], told me that if you ever allowed yourself a little time to prosecute your researches in the cosmic ray, you would naturally receive the Nobel Prize for physics. I had said that the Leonardo spirit, which seemed to possess you was more important than a prize, because it was a comprehensive awareness of the new departures from our transitional Indian civilization that demanded the attention of men like you.

I realized when I met you in Bombay in 1945, that the pioneer work of the organization of Scientific Research had already claimed you. And what you had left after your twelve hour working day fulfilling your administrative duties, was being given to your own personal research, to drawing and painting, to music and dance art, and to friendship. Thus my hunch about your pre-occupation with all the diverse phenomena of our developing culture seemed to me to be instinctively correct. And it was confirmed through all our formal and informal get-togethers.

I had visited you while you were still at the Indian Institute of Science at Bangalore, and saw how your dynamic personality had drawn together some of the most devoted younger scientists into the common pool of experience from which was to arise the Tata Institute of Fundamental Research. And when, later, I witnessed the process by which this second Institute grew into a vast organization in its fine building in Colaba (to the designing of which you gave much of your knowledge of architecture), I knew that your restless energy would soon be harnessed by Jawaharlal Nehru in a field of work which seemed to be, from our conversations with him, nearest to his heart – the peaceful use of atomic energy for the speedier reconstruction of country. The Apsara reactor at Trombay followed. And you became busy planning to give India atomic fuel at the most modest prices.



Pages from a Marg article on Bhabha's paintings
Vol. VI No. 3, June 1953;

Apart from the stimulus you gave to your colleagues in Science, by long hours of work by constant debate and discussion with the youngest men and women, I remember how you infected them with your enthusiasm for the plastic and pictorial arts. The memorable day when you brought two fellow scientists to lunch with me to argue about George Keyt's pictures will live with me, because this led to the important exhibition of this contemporary avant garde painter of Ceylon in Bombay.

Your frequent appearances in a casual non-official manner at the Artist Aid Centre confirms for many of those young talents like Hebbar, Raza, Souza, Padamsee that in you they would have a discriminating patron who would talk from within the experience of the pictorial situation rather than in the generalized manner of art critics.

During our conversations along with Karl Khandalavala, Rudi Von Leyden, in your own Studio and in the drawing rooms of Bombay, you did not allow the polite convention of superficial exchange to limit your freedom to plunge into detailed talk analysis and controversy.

I noticed the same attitude during the intervals of any dance or music recital at which we met during all these years. The nuances, the undertones and the finest fine points of each technique interested you. And you always had apperceptions of the newest possible moot points. For instance, I remember both of us exhorting a young dancer after her Bharata Natyam recital to go to Martha Graham and learn to use the inspirations of the traditional dance art for the creation of a revolutionary Contemporary Indian style.

I would not have mentioned here my own personal debt and the debt of *MARG* colleagues, to you, were it not indelibly imprinted on my mind that you became one of its first subscribers – gave a personal donation when we were in difficulties and persuaded Tata Sons to sponsor it. Later, in some of the crisis when all seemed lost, for this little organization, it was your decisive opinion that ensured its survival.

The perfectionism of your approach to everything you handled came home to me when you insisted on correcting the proofs of the Leonardo number which you had brought together as the guest editor of *MARG*. You insisted on correcting the proofs of every document four times, meticulously examined each block pull, and almost did not accept the book because a few pages were inked indifferently. Nothing could have impressed our junior colleagues about the need for precision, efficient execution and patient labour, as much as your example in passing nothing until it had been most vigilantly scrutinized.

The scientific method, which you had cultivated and applied to almost everything in your experience, like furnishing your studio at the Little Gibbs Road, or hanging pictures at the Tata Institute of Fundamental Research, or in evolving Trombay, was no mere personal eccentricity, but obviously part of your philosophy of design for living: it was the carrying over into concrete action of your belief in 'work as worship'.

And this kind of devotion which Jamshed Tata had also asked for from the intellectuals of India, in his famous letter to Swami Vivekananda, will have to be inherited by the new generation of our country if we are to achieve the new civilization of which you were one of the pioneers.

In my humble opinion, the reason why you found the pursuit of truth, and the realization of beauty, so much a part of your everyday life, was because you were convinced of the kind of humanism which some of our teachers and older colleagues imparted to us. Whatever the intimate sanctions which each one of these people may have brought to his experience, there is a common acceptance of the doctrine of worship of man in the thinking of Einstein, Bertrand Russell, Rutherford, Joliot Curie, Linus Pauling, J.D. Bernal, Jawaharlal Nehru and their contemporaries. These men accepted the finest things of the past, rejected what they could not absorb, broke down the national frontiers, class divisions and the orthodoxies, to usher us all into an emergent one world culture in which the unity of thought and action has become the method for total achievement.

In your life, more than in any other of our generation, this humanism flowered into so many fruits that the new young will taste them and remember you as one of the precursors of a new International community of intellectuals, who might make it possible for life to survive on this planet. The symbol of your belief in solidarity was your repeated interventions in favour of the use of atomic energy for peaceful reconstruction, when the major influences of the power-potentates was in favour of the use of the atom for possible war making.

If the implications of your written words are studied, these will show the instinctive choice you made for the free discussions of the turning points before our age, so that many energies may be released, among the underprivileged of this world, and social justice achieved, and when the history of our intelligentsia comes to be written, the world will know how many departures from orthodox positions you made and how many innovations you carried out. I say, in anticipation of such a summing up that you were one of the few possible 'Whole Men' of our time.

Mulk Raj Anand

A.M. Davierwalla [1922-1971] was among the first generation of modernist sculptors. He worked on wood and later on metal creating dynamic thrusting forms, jutting into space. Davierwalla recounts here that Bhabha would visit exhibitions, often returning a second time. The collection he built in TIFR was judged by many to be Bhabha's legacy. As Davierwalla put it: 'Without him art is orphaned!'

To The Editor, The Times of India

Sir-Tributes have been paid to the genius of the late Dr H.J. Bhabha as a scientist. It is fitting that they should also be paid to his role in the art world as connoisseur and generous patron. He was known and respected by every artist who had contact with him. As an artist, I shall always consider it a privilege to have been closer to him than most. His imaginative personality always fascinated me. In spite of the heavy demands on his time, he always made it possible to visit innumerable exhibitions where he spent considerable time. He was never cursory; in fact, he often visited an exhibition a second time. His grasp of art forms, old and new, was intuitive, his judgment clear and unbiased, his purchases magnanimous. Over the past decades he used the funds at his disposal to build a comprehensive collection of contemporary painting and sculpture which today ranks among the finest in the country. Dr Bhabha bought each art work after personal scrutiny, chose each frame and pedestal after considering various alternatives and finally sought a position where the work would be seen to the greatest advantage. Once an art work was included in this collection, it was not the end of it. The paintings and sculptures were maintained in perfect condition, copyrights of reproductions secured against prior payment being made to the artist. The collection was always open to the public. The message came through clear - the artist and his work was loved and cared for and the artist's self-respect never overlooked.

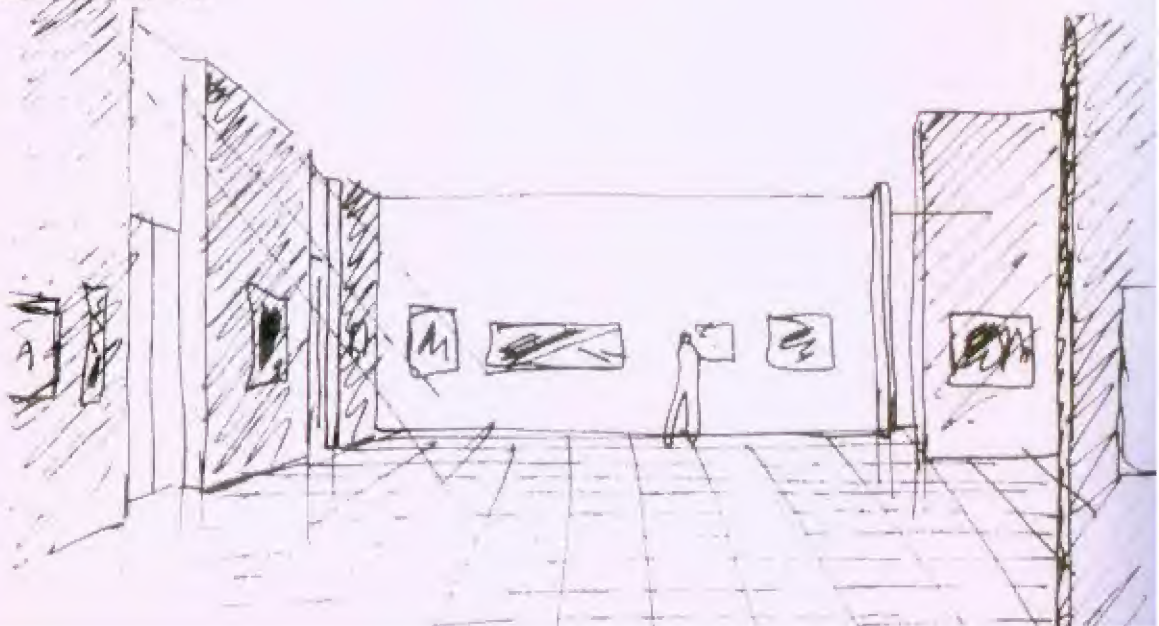
This fine collection is bereft of its patron but stands today as the legacy of a genius who was a prince among men! Without him art is orphaned.

A.M. Davierwalla
Bombay, January 27, 1966.



The first of Davierwalla's 'Quartette'. The series of four pieces was purchased by Bhabha in 1962.

Background: Sketch of TIFR foyer showing the art display by Helmuth Bartsch, designer



Homi's
Other World

Rustam B.J. Patell (b. 1925), architect, was involved in the buildings at the BARC site. He travelled with Homi Bhabha to several Nuclear Establishments in the USA and Europe to study the landscape and architecture.

The Master-planning and Layout Development of the Research Site, a venture which occupied Dr Bhabha's sustained interest and attention through ten years from the conceptual stages to the very end, was not a broad-lined exercise to which he limited himself. He took the plunge into all of the many faceted problems, even in-site engineering, that continually arose; and pursued each sometimes in the minutest detail: it could be either the major and the minor axes of site planning or the extension and restriction of vistas by the use of 'afforested space-dividers'; it would involve him in facts and figures on earthwork and level utilisation; or water conservation; or tree and ground-cover selection.

He took his architectural problems home, where, in his great study (incidentally, one of the most beautiful of rooms), he would be at the drawing board till the

late hours of the night laying out one of the 'parterres', and once in a while, there would be an after-dinner call that one had to get used to at any moment: a sort of: 'Doing-anything-tonight?' question followed, when at his house, by: 'Well-what-do-you-think-of-it?' It would sometimes be well past midnight with a particular design problem still only partly solved.

Mithoo Coorlawala (b. 1917) studied in Cambridge where she first encountered Homi Bhabha. After her return to India she became a close acquaintance of Bhabha and belonged to his close circle of friends. She is a voluntary social worker, historical researcher and author of *Covenants of Faith, Ahd na-mah* (Mumbai 1995).

IC: You told me the other day that you were a student at Cambridge when Homi Bhabha was there.

MC: I was a first year student – and he was an exalted Fellow. But he was the supervisor of my neighbour – Nancy Walls, a mathematics student. She used to pronounce his name 'Dr Bobba'! I never met him in Cambridge. But I saw him

12261

Bhabha's sketches for the parterres of the gardens of the Atomic Energy Establishment at Trombay



perform at the concert in Cambridge – he was the first violin. He also designed the stage set for the world premier of Mozart's *Idomeneo*. It was an historical occasion.

IC: You were telling me that you got to know Homi when you came back to India?

MC: We'd meet at dinner parties at Petit Hall and in the home of J.R.D. Tata's sister, Dabeh [Rodabeh] and Duggie Sawhney and at Scylla Petit's. Every year we would have a Cambridge Society play – always Shakespeare! – to collect money for our scholarship fund. So before the play I usually had a dinner party at home and Dr Bhabha would come if he was in Bombay.

I got to know Pipsy because of the Time and Talents Club. Lady Jerro Mody was the president of Time and Talent Club and Pipsy was the vice president, I was the secretary. We corresponded with Christian Dior to have a fashion show to raise money for charity. Pipsy had set up the venue on the lawns of TIFR – the ramp was set up from behind the West canteen and it ran into the lawn. The models and Marc Bohan's Autumn Collection of that year came from France. Dr Bhabha was there of course and he hosted the dinner afterwards. A very elegant affair!

I used to meet Dr Bhabha with Pipsy – they would often listen to music – some



Bhabha's stage design for Mozart's *Idomeneo*, Cambridge, 1939.

special recording or something and my husband and I were occasionally part of that. Pipsy I knew really really well. She was a dear friend, Pipsy was very beautiful. She was tall and wore a sari very elegantly and moved very elegantly. We liked each other – so we did things together.

I must tell you an amusing incident about Homi and Pipsy. They were very well respected in high society and they were always thought of as being together – and were invited together. When Homi was awarded the Fellowship of the Royal Society – it was an incredible honour. So of course, the Cambridge Society had to have a dinner in his honour. At that time the President was Sir Cowasji Jehangir and the Chairman was Bishop Lash – he was an Englishman – Church of England. We had this party and asked Homi to be the guest of honour and he agreed. But we didn't say anything about Pipsy in the letter. So he waited, I suppose, and on the morning of the party he rang me up and said, 'Mithoo, I notice that you

Homi's
Other World

haven't mentioned Pipsy. Nor have you sent her a separate invitation. Well I want you to know that I will be bringing her this evening.' So I said, 'Yes, of course, she is very welcome. We will be very happy.' Then I rang up the Bishop and said that I had this conversation with Dr Bhabha and he will be bringing Mrs Wadia. And he said, 'Oh dear, why has that learned doctor put us into this predicament!' I said, 'What predicament?' He said, 'Well, you know they are not married.' I said, 'that doesn't matter to anybody in Bombay – all over Bombay they are very well accepted and very well respected.'

The Bishop said, 'Well, you know I can't think this would be proper. What can you do to pre-empt this'. Bishop Lash was a darling man with a quaint and delightful sense of humour [at this moment vanished!] but I had to insist there was nothing we could do. I said, 'Bishop, please understand, I cannot possibly call Dr Bhabha now and tell him he may not bring Mrs Wadia with him. That simply would not work. He may decide not to come himself. And what would be the point of the party?' The Bishop sighed deeply and hung up. But he hadn't given up!

When I arrived early at the venue of our party, Ronald Archer, the vice president of our Society was already there, waiting for me. 'Mithoo,' he said, 'What have you done with the seating? You have placed Mrs Wadia next to the Bishop!' I said, 'Where else should I have put her? Dr Bhabha is our guest of honour and Mrs Wadia is the chief lady, and I have placed her between Sir Cowasji and the Bishop. I can't see

what the fuss is about.' 'Oh can't you understand that the Bishop is high church and has strong scriptural concerns about matrimony.' Ron replied. I said, 'I don't buy that,' and he said, 'Nor do I but the "Bish" is very upset, so what do you want to do with him?' In the end we switched place cards and seated Sir Cowasji and Lady Jehangir next to each other, with Mrs Wadia next to Sir Cowasji; and the Bishop sat next to Lady Jehangir who was well-married!

IC: Tell me about the tree transplant that Bhabha helped you with.

MC: Once, during a monsoon storm, two Gulmohor trees in the building where I was living were knocked down. Gulmohors have shallow roots. So I took the liberty of calling Dr Bhabha personally. I said, 'Homi can your people do something?' I reminded Homi that Gulmohor trees are not very strong and if left too long they might not take root. He said, 'Don't worry I shall see that somebody comes at once.' I remember that! He was a very positive and very effective person. He didn't let things lie. And his people came and put the two trees back. The trees are still there!

S.D. Vaidya, joined the Atomic Energy Establishment as Head of Parks and Gardens after completing a postgraduate diploma in landscape architecture from Versailles. Singularly responsible for the landscaping of both TIFR and the Atomic Energy Establishment in Trombay, Vaidya operationalized one of the first tree transplantations in India on Bhabha's request.

He asked me, 'Can you transplant a big tree, a very big tree.' I said, 'Yes'. Then he asked me, 'Why don't you do it immediately?' So I said it is a very expensive thing, and in India, we would not normally spend thousands of rupees for transplanting a tree. But he said, 'No, if you think you can do it, I want you to tell me I can do it.'

This was a rain tree by the roadside; and because the road was being widened, that tree had to be cut. He said, 'I don't want to cut it.' So I said, 'Yes, we can transplant it.' I was staying in Kenilworth, so I said we can transplant it to inside Kenilworth. Then he asked me the details, 'How will we take it inside?' So I told him it can be lifted by crane, and the crane can put it inside, and we will straightaway transplant it. Until then, nobody would even think of transplanting such a large tree. This was the first time.

M.R. Srinivasan, former chairman of the Indian Atomic Energy Establishment speaks of Homi Bhabha's legendary love for food.

Dr Bhabha loved good food. I once met Bhabha at his hotel suite in Washington, along with my colleagues M.N. Chakravarti and M. Dayal. We were to meet the US delegation to discuss matters related to the Tarapur project. Bhabha told us that he had had an uncomfortable night with an upset tummy. We called up the medical doctor attached to the Indian embassy for advice. He told Bhabha to have yogurt and keep himself light. So Bhabha ordered grapefruit, poached eggs, toast, coffee

and two helpings of yogurt. After the meeting in the forenoon, the four of us went to a French restaurant offering good fish. Bhabha ordered a soup and poached fish. Later he asked for yogurt, which this fashionable restaurant did not serve. A waiter had to be sent to a nearby supermarket to get yogurt for Bhabha. The doctor had prescribed yogurt instead of other food, but Bhabha thought it was yogurt in addition to normal food!

The last time I saw Bhabha was about ten days before his untimely death. The International Council of Scientific Unions had met in Bombay in January 1966. One evening at the Governor's residence, Bhabha asked me if there was a Bharat Natyam programme in town that evening to which he could invite his international guests. At that time, Rukmini Devi, the founder of Kalakshetra, was staying with us. Her group was performing at the Kishanchand Chellaram College, near Churchgate. I told Bhabha that Rukmini Devi would be very happy to receive Bhabha and his guests. At the intermission, Bhabha and I walked to the nearby Ritz Hotel as he wanted to make a telephone call. Bhabha was in a reflective mood and said, 'People tell me that I am too fussy and want perfection in everything. I know I can move ahead faster if I relax the standards. The trouble in India is that we have lost our quest of excellence. Look at our dance and music and this evening's programme – here we saw perfection. I want to prove that we are once again capable of achieving that perfection.'

Bhabha's sketch of
Mrinalini Sarabhai,
1943.



Homi's
Other World

Mrinalini Sarabhai (b. 1918), is a renowned classical dancer and wife of the late Vikram Sarabhai, who is often referred to as the Father of the Indian space programme. It was through her husband that Mrinalini Sarabhai met Homi Bhabha for the first time in Bangalore.

I first met Homi Bhabha in Bangalore. He was a professor at the Indian Institute of Science where Vikram was studying. I did not know anything about him till we were introduced and I was very impressed by his sophistication. We did not really have any special interactions with him except when a few of us would meet and talk about various subjects. Homi was very interested in painting and music and so was Vikram. My husband and I shared his love of painting and music. Homi and Vikram also often had conversations on scientific subjects. I don't really know of his scientific contributions but his passion for music and painting was something I understood. He wanted to draw me as

he was a very good artist. He made two portraits of mine. Once in Mexico, where I was dancing, he and Vikram had come to see me perform. Earlier I had teasingly asked Homi which lady he was going to bring and to my astonishment he came with the actress Dolores Del Rio!

Kekoo Gandhi (b. 1920), is the founder of the Gallery Chemould, Bombay and has been an active participant in the contemporary art movement in India.

KG: Homi was one of our first customers. Homi himself used to paint, and he was buying paintings also. At that time, he was in Kenilworth so he would go home for lunch and in the afternoon he would be coming into the Fort area and he would stop at the Princess Street framing shop, and there Roshan Kalapesi was the person who served him. I remember that Homi would spend hours there; he would take a picture ask a man to hold it up then talk and forget to ask him put it down!

Then Roshan suggested that we should have an exhibition, so in the frame shop Roshan arranged an exhibition and Homi inaugurated it. He and his friend Pipsy, who was his constant companion would come to all the exhibitions. She was much older than him; one didn't exactly understand the relationship.

IC: She was a connoisseur; she chose many of the paintings. Especially when the mural at TIFR was done - she was on the committee that chose the final mural.

KG: I was about to say that! Homi's habit



Jehangir Sabavala's 'Seagulls and Sails', 1962. TIFR Collection

Krishen Khanna, 'Spring Nude', 1954
TIFR Collection



was always to talk to the artist. He had more or less an unwritten agreement with us. Since he was buying for TIFR and for the first time a good selection of paintings was going under one roof, we made it a point to ask him to come a day earlier, before anybody else saw the paintings.

IC: And he had the privilege of the private preview.

KG: Yes. That was something I was very proud of and I would say the best collection of the 1940's and the early 1950's is in TIFR.

Jehangir Sabavala (b. 1922) pre-eminent modern Indian painter recollects his experience of Bhabha's appreciation of art.

I knew Dr Bhabha personally but always at a distance. However, at an exhibition of mine held at the Jehangir Art Gallery, Bombay, in 1961, somebody from TIFR came to the show and bought the painting 'Seagulls and Sails', a seminal work for the Institute. So that painting entered

the collection when it was quite new and young.

Dr Bhabha, of course, had an 'eye' – he got the Institute to build this wonderful collection of modern Indian art, and I remember visiting their gallery some time in the 1960s and seeing the collection. I also remember that one of my paintings called 'Leaves, a violin...', a still-life painted in Paris in the late 1940s was loaned to TIFR for a considerable time. The painting was the private property of Mrs Pipsy Wadia, and Dr Bhabha and his committee decided that it would hang well, alongside the other works at the Institute. And there it remained till the owner's death in the 1980s. And so one gathers that there was this practice of also borrowing worthy works and displaying them together with the paintings of the permanent collection at the Institute. And unquestionably Dr Bhabha was the leading light and the guiding hand of the whole project.

Krishen Khanna, (b. 1925) worked at Grindlay's Bank after he came to India



In October 1962, Homi Bhabha invited twelve modern Indian artists to submit preliminary designs for a mural for the wall inside the entrance hall of the new building. Bhabha and the committee he appointed chose Husain's design. As Bhabha wrote in 1963, he expected Husain's full-scale mural to be 'richer in texture and detail than the sketch'. Husain painted the mural at TIFR completing it in 1964.

Homi's
Other World

following the Partition. He joined the Progressives Artists Movement while he was in Bombay. He held his first major exhibition in Bombay. Khanna recounts how he came to sell his first painting to Homi Bhabha.

I was not privileged to know Dr Homi Bhabha personally. I came to Bombay soon after the partition of Punjab and was fortunate in getting a coveted appointment in Grindlay's Bank. I was painting on the side and I was asked to join the Progressive Arts Group by my friend Husain who incidentally knew Bhabha well. It was he who sold my very first painting to Dr Bhabha for the collection he was making for TIFR. I was in Grindlay's Madras office at the time when I received a telegram from Husain telling me that he had sold one of the paintings which I had left with him when I left Bombay. He had sold 'Spring Nude', a small painting in oils for two hundred rupees.

I still remember the thrill on receiving this news. And now, thinking over the many

years which have passed, I think that the initial momentum created by Dr Bhabha is in some way responsible for the many fortunate events which came my way. I bear a sense of gratitude to someone who instigated events of which he was never aware.

Maqbool Fida Husain (b. 1915) is one of India's acclaimed modern painters. Bhabha inaugurated M.F. Husain's first one-man show at the Chemould Gallery in 1954. Husain was commissioned by Bhabha to paint a mural for TIFR in 1962. In exile since 2006, Husain was interviewed on the telephone for this book.

IC: Husain-saab, when did you first meet Dr Bhabha?

MFH: I met Dr Bhabha first in 1954. I had just come back from Europe. Dr Homi Bhabha opened my one-man show at the Chemould gallery.

IC: After you met him, did your impression about him change?



Extreme Left: The entrance foyer of TIFR with B. Vithal's head of Bhabha seen at the foot of the stairs. Husain's mural *Bharata Bhagya Vidhata* is seen on the wall above. (Photograph by Nrupen Madhvani)

Left: Bhabha's sketch of M.F. Husain, 1961

Facing Page: Husain's sketch for the same mural.

MFH: Yes it did change. He was the most successful scientist of our country. But he was so humble. He was more like a painter than a scientist. His drawings are almost like those of Leonardo da Vinci.

IC: When he sketched you did you sit for him?

MFH: Of course, I went to his house. At that time once or twice in the month we used to meet in his house. TIFR was under construction then. The gardens, the entire landscaping – he did all of it. He was also an architect and a visionary. And another pioneering thing he did was that he started buying paintings for a permanent collection at the Tata Institute. Many people objected saying why is so much money being spent on paintings? But I remember Jawaharlal Nehru stood up and defended him, saying there was a strong link between art and science.

IC: The first two water colours of yours that are there in TIFR – one is called

'Yellow Face Tempera' and the other is 'Mother and Child' – both are dated 1954. Are they from your first exhibition?

MFH: Yes they are. He bought them then.

IC: Can you recall something about 'Bharat Bhagya Vidhata', the mural you did for TIFR?

MFH: There was a wall space of 40 ft by 10 ft. And Dr Bhabha wanted a mural there. He invited different artists to send their paintings. He said they would pay all those who would send in their work. Among the artists invited were Jamini Roy and some other leading artists of India. There was K.H. Ara, who was the darling of high society at that time. I thought I would never get a chance! Rudi von Leyden was on the selection committee – Ara was a great favourite of his. On the last day – I was to submit the drawing by 4 p.m. – even in the morning I was not sure whether I should send one at all. But my friend said it didn't matter whether I got chosen, I should definitely send it. So I sat down

with some crayons and did it very half-heartedly. I thought there was no point to it. Anyway, I submitted it. Then a month, two months, three months passed. I went to Pipsy Wadia, who was Bhabha's friend, and asked her what was happening. She was surprised that I hadn't heard anything. She went inside and phoned Dr Bhabha. Then she came out and said, 'You got the mural.'

IC: Then you spent a lot of time painting it?

MFH: Yes. I loved it! I wanted to meet and interact with all the scientists. Later on I did a series of paintings on art and science.

At TIFR I got a room and my name was there on the door. There were scientists all over the world and they had their names on the door and so did I! There was a canteen and I used to have lunch with them. I could have finished the mural in 2-3 months but do you know how much time I took? I took two years, because I wanted to spend more time at TIFR [laughs]. Those two years I really enjoyed myself. Bhabha would come to see me paint.

IC: One of the things I remember about the report on your painting was that Bhabha felt that the texture of your work was far superior to anything he had seen.

MFH: Those must have been the words of Pipsy Wadia! [Laughs]. Actually I think what stood out in my painting was the theme. I always try to portray what is India, the essence of Indian culture. You know how in the name of modern art you can do anything – then you describe it with all sorts of philosophy and theory. But I am like a folk painter. It's not high intellectual art.

IC: Why did you name the mural 'Bharat Bhagya Vidhata'?

MFH: It's because I showed the grandeur of India.

IC: What do you think was Bhabha's most important contribution to the world of art?

MFH: His collection at TIFR. It is a unique collection. He selected the best. It is the nucleus of Indian contemporary art. It is something that you won't find anywhere else.

IC: Do you remember the day he passed away?

MFH: Yes. He died in the plane crash. I was in Bombay that day. I heard it on the radio and was very shocked. You know he would always carry a painting kit wherever he went for international conferences.

The artist contemplates his art. Bhabha with his sketches at his home. c. 1960s.



10. A WORLD WITHOUT HOMI BHABHA

'On a sudden there is a gaping void, and men are left masterless, their sense of direction lost, their purposes reduced to nothingness; for in that whole world of atomic energy and fundamental research "presiding everywhere upon event was one man's character". The mood must change. To indulge in lamentation or feel that everything is over were poor tribute to his strong, confident, masterful spirit.'

Restum Choksi, 'A world without Homi Bhabha', A personal tribute, 31 January 1966.

When they first heard the news, nobody was ready to believe it. The Kanchenjunga – a Boeing 707 aircraft in which Homi was travelling to a meeting in Vienna had crashed into the Glacier des Bossons of Mont Blanc at 4807 metres. There were no survivors.

For Homi's family, friends and colleagues it was an unreal moment. A savage blow. They were stunned. Speechless. Some waited for the latest radio bulletin nursing a faint hope about survivors. His friend, Jeh rushed to the spot.

The meeting of the Advisory Committee of the International Atomic Energy Agency (IAEA) at Vienna opened with a silent homage to Homi Bhabha. Back in Bombay, at his Institute, his colleagues held a meeting and went back to work in a daze, still reeling under the weight of unfathomable loss.

He died on 24 January 1966; that same year in October, the road to TIFR, his beloved Institute was named the Homi Bhabha Road. The AEET became the Bhabha Atomic Research Centre. Almost two years later, the TIFR auditorium which now bears his name was inaugurated



Members of the Scientific Advisory Committee of the International Atomic Energy Agency at Vienna paying their respect to Homi Bhabha on 25 January 1966.

by Prime Minister Indira Gandhi on 9 November 1968. The first Homi Bhabha memorial lecture was delivered by the cosmic ray physicist, Cecil F. Powell on 'The Aims and Role of Science in our Time' – a theme that echoed Bhabha's own concerns. Powell also used the occasion to express 'on behalf of the community of physicists all over the world, how much we miss Homi and how deeply we regret his loss'. Powell ended with a poignant reading of 'The Lament for Imogen' from Shakespeare's *Cymbeline*:

Fear no more the heat o' the sun;
Nor the furious winter's rages,
Thou thy worldly task hast done,
Home art gone, and ta'en thy wages;
Golden lads and girls all must,
As chimney sweepers come to dust.

Homi the energetic institution-builder was gone. The institutions endured as his legacy. They came of age, matured and went through inevitable changes; the cherished image of their founder stood frozen in time – immutable, changeless. And even after a hundred years, still in his prime.

Amalendu Dasgupta (1924-2008), Editor of the *Statesman* (1980-1986) had joined the International Atomic Energy Agency as its Press Officer in 1958. He joined the *Statesman* in 1964 as Assistant Editor, also taking on the responsibilities of Science Correspondent. He shared a cordial relationship with Homi Bhabha who always informed him about developments at the Atomic Energy Establishment Trombay.

Dr Homi Bhabha's death is the most grievous blow that Indian science could have sustained at this time. There was in him an extremely rare combination of individual brilliance, a passion for organizational development supported by unbounded energy and drive, and a remarkable ability to lead and inspire people associated with him.

His own scientific work had in recent years been overshadowed by his organizational achievements, but it should not be forgotten that he was already a physicist of a very high calibre before he achieved eminence as a builder of the Indian atomic energy development programme. His work on cosmic rays remains a landmark even in a field in which new ideas and discoveries have been both numerous and fundamental in recent years.

The academic purist might regret that after the great promise he showed in the late thirties and forties, Dr Bhabha had progressively less time to devote to his own scientific pursuits. But the nation as a whole has reason to be grateful that he thought it worth his while to do all he could to organize scientific research and development in this country. Being a theoretical physicist, he was first interested in building a centre for fundamental investigations into physics and mathematics, the result was the Tata Institute of Fundamental Research, whose distinction is now recognized all over the world.

The Tata Institute also served as a nucleus for the wider and much larger programme of atomic energy which was gradually developed again almost entirely on Dr Bhabha's initiative and mostly through his own effort. The whole atomic energy programme has throughout been so dependent on his leadership that it has never been possible to consider any aspect of this programme except in terms of his own ideas, plans and efforts, in no other country perhaps has a science programme of comparable dimensions been so decisively and thoroughly determined by its scientific head. That he did an extremely good job of it nobody will deny. It is greatly to be hoped that his own dynamism and vigour has so permeated the programme as to enable it to keep up its own pace of progress.

On this point, however, it is not possible to be absolutely certain at this stage. Soon after Mr Shastri had formed his cabinet, I asked Dr Bhabha why he had declined the offer of appointment as Minister of Science. He said he did not think that the atomic energy programme had reached a stage at which it could move forward without any further personal enterprise or guidance on his part. But he said he was sure that it would reach that stage within a short time and thereafter he would be available for any other work that he might be called upon to perform. I reminded him that his dynamism and personal influence would be useful in wider areas of India's scientific activity that his zealous concern for atomic energy perhaps deprived certain other important branches of scientific research of some of the support which they deserved. He agreed that it was not impossible, but he had a job to do and he would rather do it well than become ineffective in trying to do too many things at the same time.

Excerpt from *The Statesman*, 25 January 1966, Grievous Blow to Indian Science, By Our Science Correspondent.

Vikram Sarabhai (1919-1971), physicist, who founded the Indian space programme, had been closely associated with Bhabha during his time at IISc, Bangalore. Sarabhai movingly described Bhabha's role in India's scientific development. Shortly afterwards, Sarabhai came to occupy Bhabha's position when he became the chairman of the Department of Atomic Energy.

A World without
Bhabha

"We meet with sorrow in our hearts to mourn the tragic death of Dr Homi Bhabha, who stood at this very place three days ago. We meet to pay homage to the creator of all that we see around us here and to much else in the modern image of India.

Most of us here who have come into contact with him in his later period have known Bhabha in a different role as a leader in science, as the man who after independence enjoyed great trust of Pandit Jawaharlal Nehru and who fulfilled this trust by creating a new confidence, a new image for modern India, an image in the most sophisticated areas of science. The Tata Institute of Fundamental Research, the Atomic Energy Establishment at Trombay and the many other operations which he was directly responsible for in different parts of the country, are living examples of his tremendous contribution. He enthused countless others by the standards which he set not only for himself but for all those who worked with him. His philosophy was one of self-reliance and of self-respect. He was willing to stake his reputation for achieving the most difficult tasks, rather than take the easy way. He was a strong advocate for the creation of a new culture in Indian science and Indian engineering – in Indian life, which did not perpetuate from a different era the norms and traditions of a bureaucracy. He was not conscious of seniority or status and all through his work, we have seen an adherence to excellence in work, in form and in method. If, indeed, there was a pace-setter in modern India, Bhabha was this pace-setter.

12621

Bhabha's leadership in science extended beyond the shores of this country, in the peaceful uses of atomic energy, within the committees of the United Nations and of the International Atomic Energy Agency. He gave a new status to science in the developing countries. His thinking was original in a fundamental way and was so much out of line of norms under which people in the developing countries were accustomed to think. It was told to us that atomic energy and the sophisticated realm of science should be left to the more developed nations till we had tackled the more fundamental and basic problems of getting out of a 'cow-dung' economy. And, while there might be many different opinions on this matter, the confidence and the spirit which Bhabha



Vikram Sarabhai speaking at the condolence for Dr H.J. Bhabha at AEET, Trombay, 25 January 1966

was able to generate not only in the Department of Atomic Energy but in countless scientists and young people who came out of universities, the constant support which he secured for young people – these are the priceless legacy which he has left to us.

Bhabha's interests extended to many diverse aspects of science and world affairs, to the problems of development, of security, of international affairs. Recently he was applying himself to these diverse tasks with increasing energy. Our Prime Minister Shrimati Indira Gandhi was not exaggerating when she said that the loss of Bhabha is going to be a loss which the nation is going to feel in all its diverse fields of activity. Bhabha demonstrated better than most other people I know that those who are trained in the thinking of abstract science are also those who can most successfully apply themselves to the practical tasks of the nation. And I feel that Bhabha, had he been spared this cruel fate, would have made even greater contributions to the development of modern India and to the solution of many problems in the difficult times that we are all going through today.'

Excerpt from speech by Vikram Sarabhai, member, Atomic Energy Commission, at the condolence meeting held in homage to Dr H.J. Bhabha at AEET, Trombay, on 25 January 1966.

Rustum Choksi eloquently drew out what his friend, Homi meant to him. He along with J.R.D. Tata continued to guide Bhabha's Institute.

In the hour of his death his achievement in quantitative terms was so considerable that it had no parallel in India in the combined fields of science, technology and industry. Had he lived for even another decade it would have been colossal.

There is one other touch of quality – the Homi Bhabha touch. Everything was conceived and finally executed in terms of beauty. The aesthetic sense triumphed and gave new meaning to all the monuments of his hand, whether it was an office chair, a piece of laboratory equipment, a hall of engineering, an atomic reactor and finally the whole Trombay establishment, which is a garden and landscape wonder of abiding loveliness, as much as it is the finest complex of science and technology that this country will ever know.

A World without
Bhabha

Is it idle and comfortless to speculate where he may be now 'in the sounding house vast of being'? Whether, the body smashed to smithereens, the indomitable spirit soared into the empyrean? There is no way out in such questioning for one who writes this tribute.

Better to return to the images that come crowding of the manifold ways he had of pleasing or getting his way! He was warm, gracious and generous in his appreciation of quite trivial things. His zest was phenomenal. He was so intensely interested in food, cloth or clothes, in furniture, in ornaments, in flowers, in trees, in colour, shape and form of every slightest thing. When another deprecated some small thing shown to him, how often he would say, 'what's wrong with it? I like it.' Did he like it, he with his impeccable taste, his wide range of experience in the arts and crafts of many lands, he who has been likened to Leonardo da Vinci? Or was it some instinct of mercy and gentleness, some innate gift of wide-ranging comprehensive sympathy, that promoted this response?

What was more fitting than that on 26 January, the ceremonial service for him should be held in his own Institute, in that temple that he had built for other worship. There amid the utter serenity and dignity of the long colonnade and the vista of sea and landscape of green lawns and trees, men and women of all faiths could do him their last homage.

12441

Sometimes, when evening comes and he is expected, how vividly he stands in visible form of his own dear self. One loved him well but one did not know how much – till now.'

Excerpt from Rustum Choksi, 'A World without Homi Bhabha: A Personal Tribute', dated 31 January 1966.

The Uthamna Ceremony for Homi Bhabha was held on 26 January at TIFR. As Rustum Choksi put it: 'What was more fitting than that on the 26th January, the ceremonial service for him should be held in his own Institute, in that temple that he had built for other worship.'



The Uthamna Ceremony for Homi Bhabha held on 26 January 1966.

Above: Prayers offered at the Uthamna ceremony.

Left: Mrs Shirreen Jeejeeboy and Mr Dinshaw Panday, relatives of Homi Bhabha directing the arrangements.

Right: Priests praying at the ceremony.

M.G.K. Menon succeeded Bhabha as director of TIFR. He spoke at a meeting organized by the Sheriff of Bombay to mourn Homi Bhabha.

Homi Bhabha died at the peak of his great powers, a legendary figure in his own lifetime, working towards the end with an urgency which had to be seen to be believed, working against time when he felt he had so much to accomplish, with more visions that would lead to a modern India and a better life for its people. All of us left behind carry very heavy responsibilities to transform these into reality as he would have done. That is the only tribute we can pay him and we shall.

The legacies he left behind are not only the tangible programmes, buildings, equipment, gardens and the like, visible creations of his scientific and artistic abilities; but even more important is the legacy which is in some sense, intangible – the large number of trained personnel, who have embraced the vision of a new India and who have acquired confidence in their own abilities. Blackett has often stated that a first rate laboratory is one in which mediocre scientists can produce outstanding work. Homi Bhabha being above all of outstanding distinction understood this well and this is what he sought to create by the right environment and right conditions for work. He succeeded in enthusing those who worked around him with the same spirit of dedication in national endeavour which motivated him, enthused them to maintain the highest standards of scientific integrity and in setting standards of quality in all that they did. This viable, self-generating group of trained personnel, the scarcest commodity in a developing nation, products of Homi Bhabha's inspiring and warm leadership, are his richest legacy to this country, which has indeed been fortunate in having such a son.

Excerpt from M.G.K. Menon, Speech at Sherriff's Meeting in Memory of Dr Homi Bhabha, at University Gardens, Bombay, 12 March 1966.



On 24 January 1967, exactly a year after Bhabha died, J.R.D. Tata gifted B. Vohal's Head of Homi Bhabha to the Institute. Seen here are M.G.K. Menon, J.J. Bhabha, J.R.D. Tata and Rustum Choksi.

RECOLLECTIONS

J.J. Bhabha, younger brother of Homi Bhabha.

You know, you talk about destiny – Homi was not scheduled to go on that flight. Homi had been appointed the first chairman of the International Commission for the Peaceful Uses of Atomic Energy. He had been appointed by the first United Nations boss – the Secretary General, Dag Hammarsköld. But the meetings were scheduled to be held in Vienna. In those days, you couldn't fly direct to Vienna; you had to fly via Geneva. So Homi had been booked to go to Geneva by a later flight – that flight, as it happened went through safely. My Mama never got over that. The earlier flight he took is the one that crashed.

When this call came to break the news about the air crash – I could only say, 'No! No!' I refused to believe it. My wife, Betty rushed to the telephone and took it over from me. Then our task was to break the news to Mama who was on the upper floor. So I went with Betty – she did the talking.

S. Ramani (b. 1939), Computer Scientist, joined TIFR as a Research Associate, and

then served as a scientist at various levels, and was the first director of National Centre for Software Technology.

I remember the tragic day when Dr Bhabha's flight was 'lost'. It was 10 O'clock in the morning – it was a holiday because I remember I was in the East Canteen and it was following a holiday schedule. And there I saw Puthran, the Registrar. Typically Puthran used to come to the East Canteen around that time on holidays and he would be wearing his shorts. He would walk around the beach and then have a cup of tea. So I saw him – no shorts that day – but trousers! So I asked, 'You are not wearing your shorts – what is the matter?' And he said, 'Ramani, Bhabha's flight is reported overdue and we are afraid that it might have crashed.' And I remember it felt like the whole world was crashing around me! It was a great loss – a personal loss – because Dr Bhabha was a father figure for us. At that very moment I remembered that just the previous Saturday – or may be the Saturday before that – Dr Bhabha was standing about 10 feet away from where Puthran and I now sat – he was looking through the glass and pointing out some

The road to TIFR was renamed Homi Bhabha Road on 17 October 1966. M.G.K. Menon, J.R.D. Tata and others at the ceremony.



A World without Bhabha

trees outside to an engineer. Somebody had ordered these trees to be cut. He was furious about that! Later at the Institute, I remember Parsee rituals were performed for him.

Suresh H. Sawant, a TIFR workshop worker, grew up helping in the Bhabha household where his father was a security guard.

My father used to work at Dr Bhabha's house and I used to go there with his tiffin. I was just fourteen or fifteen. We used to sit around and have tea – I used to sit on the floor – and Dr Bhabha would call me and say, 'Come sit here at the table.' I used to walk the dog with him. Sometimes Dr Bhabha would sit and read and I would take the dog for a walk in the garden. I remember that Dr Bhabha's dog was a small one, grey in colour and very fluffy with very long ears, I can't remember his name. The dog just loved Bhabha-saab – he used to come running and lick his feet as soon as he came back. Afterwards on Dr Bhabha's recommendation, I was interviewed for a job at TIFR. After I joined I met Dr Bhabha and he said, 'Do your duty

Work well and make your father proud.' He used to talk to us in Hindi – a little bit of Marathi, but Hindi mostly.

When we heard the news of his death on the radio, none of us believed it! We went to the bungalow. A lot of important people had come, so we couldn't meet his mother. Later we met her. I just didn't like to see her cry. And when Dr Bhabha died his dog did not eat anything for more than a month. The doctor would come and give it medicine, but the dog would just drink some water and refuse food. Slowly he died.

Rati Cooper and Perin Boga are sisters and are relatives of Homi Bhabha. Rati Cooper was the principal of Rajkumar College, Rajkot while Perin Boga taught at Kinnard College, Lahore where she still lives.

'You are in Bombay. Why have you not been to visit me?' Such was Meher Aunty's attachment to all members of our family – her family – and, indeed, our attachment to her. She was especially fond of the younger generation and, actively interested in our



A commemorative stamp and first day cover was released on 14 August 1966. The stamp included a line of musical notation from Beethoven's Ninth Symphony which was Bhabha's favourite.

lives and professional pursuits. It was clear Homi and Jamshed were constant beneficiaries of her attention and it would have meant the world to them. A prolonged widowhood had established a life-long bond between Meherbai Bhabha and her sons who represented the epitome of all that was finest in the arts and sciences. They were proud Indians who were world class citizens with professional agendas that cut across all barriers. Meherbai and Jehangir Bhabha had endowed their sons with wealth, no doubt, but this was far overshadowed by their exemplary upbringing and their unique attributes of intellect and compassion. Meherbai was generosity and love personified and by her own example she inspired her sons and so many others.

Family did, as mentioned, mean a lot to Meherbai Bhabha. On 31 December 1965 she invited as many as were in Bombay at the time, to dinner at 'Meherangir', her elegant residence on Little Gibbs Road. She chose to entertain us in the formal dining hall on the ground floor, where Prime Ministers, royalty and distinguished professionals and family and friends had

been recipients of the Bhabha hospitality. What caught the eye immediately at the far end of the room was a beautiful life-sized portrait of Lady Tata, resplendent in a gorgeous sari and jewels, as if presiding over the guests. Our gracious hostess, dearest Meher Aunty, sat at the head of the long, rectangular table, head covered, simply dressed in white. She had already supped on a menu of boiled fare at seven in the evening as was her custom but for us she had planned a sumptuous New Year's eve dinner. There were savouries and fish and meats and a host of delicious dishes to which it was impossible to do justice. Just as well we had been warned to come with good appetites! The piece de resistance, however, was to arrive at the very end of the meal. John, the butler, was summoned. The lights were switched off; the crystal table centre-piece was removed and in the shadows, arms placed a large platter in its place. A match was struck, brandy poured, a momentary glow and a Christmas pudding kindled in traditional style was ready to be enjoyed. Much too generous slices were cut and served around and inevitably there was a deep and meaningful silence!

We were then ushered to Meherangir's top floor, where Homi and his faithful dog Cupid, resided. It was a vast room. Glass from floor to ceiling let in a breathtaking, panoramic view of the Indian Ocean. At the far end, an alcove served as a bedroom; on the right, was a writing desk behind which was his own painting inspired by Mozart's Aria, 'Dove sono i belli momenti'; nearby was a draughts-board with sketches on it. On the opposite side was a recess with a music stand and manuscripts and a violin ready to be played; close by there was an easel, palettes and brushes for painting.

The room lead out onto a spacious terrace filled with botanical specimens from all over the world. Homi seldom returned from an overseas visit without samples of rare plants and herbs and never, without a bottle of perfume, which his mother treasured.

1966 was just a few minutes away. Assembled on the terrace, with glasses of sherry, we viewed the harbour full of ships decorated with multi-coloured lights and buntings, poised to welcome the new year. At the stroke of the midnight hour, each vessel whistled out loud at various pitches and a toast was raised to the health of our gracious hostess, Jehangir and Homi and all members of our family.

None of us realized we were witnessing the last of such a happy assembly. Twenty-four days later, Homi Bhabha was on his way to attend a meeting of the Scientific Advisory Committee to the International Atomic Energy Agency in Vienna. The Air-India Boeing 707 with a hundred and seventeen people on board, crashed on Mont Blanc. Meherbai Bhabha's beloved son, Homi, was gone forever.

Bhabha's painting was inspired by the Countess' aria 'Dove sono i belli momenti' - 'where are the beautiful moments of sweetness and pleasure' from Mozart's opera *The Marriage of Figaro* (1784). This painting was exhibited at the Royal Academy Exhibition of Indian Art at London in 1948. It hung behind Bhabha's desk in his study at home.



'Homi Bhabha was to me one of the three most remarkable men I had the privilege of knowing in my life. One was Jawaharlal Nehru, the second was Mahatma Gandhi and the third was Homi Bhabha. And when one tries to think of the future and how history will be regarded by future generations I think it would be right that it should be felt that Homi Bhabha was certainly one of the three greatest Indians that have lived in the past in this century. Homi was not only evidently, in a subject which is far and totally beyond my own comprehension, a great mathematician, a theoretical physicist, scientist generally, he was also a great engineer, master builder, master gardener. It is something that I personally used to tease him about and admire in him – his great sense of natural value and the fact that whatever he built had to be beautiful and had to have gardens. His concept of gardens was something that would have to be related to the kings of France of a couple of hundred years ago of Versailles and elsewhere.

Homi was an artist. Homi was all that I said and he was a great human being. In fact, of all the men I have known, including the other two I have mentioned, Homi was the only one I would say was a complete man.'

Excerpt from J.R.D. Tata's speech on the occasion of the release of the book, *Collected Scientific Papers of Homi Jehangir Bhabha*, 27 March 1986.

Homi Bhabha at his desk at home. On the desk is a portrait of his father and behind him hangs his own painting inspired by the Countess' aria from Mozart's *The Marriage of Figaro*. This photograph taken a few years before his death, shows Bhabha with his gaze turned away from the camera, as if looking beyond what is before him.



A NOTE FROM THE AUTHORS

This book is about Homi Bhabha – scientist and organizer extraordinaire for Indian science, as well as artist and connoisseur of the arts. He was also, as his friend, the industrialist J.R.D. Tata put it, master-builder and master gardener. While presenting this life of a myriad shades that had an impact on so many domains, we were faced with the excitement and the challenge of representing its vibrancy and dynamism. In our attempt to share the rich material we had compiled, we tried to move beyond a simple biographical model by setting up a dialogue between the narrative and the historical material previously locked away in archives. This amalgamation, we hope will reveal to the reader, the larger historical context that intricately configured Bhabha's life.

Despite the plethora of archival material available, there was very little by way of personal diaries that would help us understand the interior landscape of Bhabha's mind. What came to our aid were letters he wrote to his friends and his family, and telling incidents that his contemporaries recollected. His students, younger scientists, workers of humble origin – all shared with us the small details that made up the building blocks of Bhabha's life and created the matrix of his extraordinary dreams. Therefore, many people have contributed to the making of this book. Their names appear within the pages of this book and each one of them is immensely valued. We feel a deep sense of gratitude towards them all.

To enable research, the TIFR Archives made available its rich resources: correspondence, photographs, manuscripts and oral history interviews. It was Professor Shobo Bhattacharya, former director TIFR whose vision and deep historical understanding made possible the setting up of these Archives. To him we are grateful. We are extremely thankful to Professor M.G.K. Menon for his affectionate, enthusiastic and generous support for this project. We thank Professors B.V. Sreekantan and S.M. Chitre for their advice and counsel. Professor Mustansir Barma, director, TIFR has been a source of support for us. We would like to acknowledge the help extended by Professor Spenta Wadia, convenor, TIFR Endowment Fund and Mrs Uma Mahadevan, member-secretary, TIFR Endowment Fund. We are grateful to Mr. J.D. Isloor and Ms Vrunda Pathare (currently Chief Archivist, Godrej Archives) who began the collection at the TIFR Archives. Mrs Oindrila Raychaudhuri, Archivist, TIFR Archives extended to us her kind and invaluable help by giving unstintingly of her time to track down valuable archival material.

The late Dr J.J. Bhabha encouraged and welcomed the inception of this project. We regret that he is not there to see the book completed. We are indebted to Mrs Maki Masani for providing the TIFR Archives with an organized collection from the office of the Late Dr J.J. Bhabha. We are grateful to the Estate of Dr J.J. Bhabha and the National Centre for Performing Arts, Mumbai for giving us permission to reproduce archival material of Dr Homi Bhabha in our book. We are very grateful to Mr Khusroo Suntook, director NCPA. We would also like to thank Mr Horna Petit, Mr D.B. Biswas, Mr Rustom B.J. Patell, Mr T.N. Daruwalla and Mr Darius Dalal. We are very grateful to Lawrence Liang of the Alternative Law Forum Bangalore for guiding us through copyright issues.

Without the prompt and generous support of Professor Anil Seal we would not have been able to procure archival material from Cambridge University. To him we are deeply grateful. We thank the Malaysian

Commonwealth Studies Centre, Cambridge, for making available funds to disburse costs of scanning and licence fees. We would like to thank Professor Peter Littlewood, Head, Cavendish Laboratory for enabling us to reproduce here the portrait of Sir Lawrence Bragg painted by Dr. Homi Bhabha and Hugh Carmichael. Mr James Cox, Archivist, Gonville and Caius College, Cambridge exemplifies the spirit of generosity – he not only sent us material from the college Archives but also made special efforts to trace for us the resources at Cambridge. We would like to thank Mr. Frank Bowles, Ms. Lynda Unchern of the Cambridge University Library and Imaging Services and Ms. Caroline Herbert of the Churchill Archives Centre for their assistance.

We are grateful to Professor Karl Grandin, director of the Nobel Archive and Ms Anne Miche de Malleray, Archivist for sending us the papers related to Dr Bhabha's nomination for the Nobel Prize. We are indebted to Ms Joanna Hopkins, Picture Curator of the Library of the Royal Society, for making available Dr Bhabha's Certificate of Election from the Royal Society Archives. Thanks also to Dr Joseph Anderson, director Niels Bohr Library and Archives for useful advice. We thank Dr. N. Balakrishnan of Nehru Memorial Library and Archives, Dr Pramod Mehra of National Archives, New Dehli, Ms Deepthi Shashidharan and Mr R.P. Narla of the Tata Central Archives and Dr A. Ratnakar of Informatics India for their help. We thank Ms Radhika Sabavala, General Manager of *Marg* for permission to reproduce material from *Marg*. Thanks to Professor Dipan Ghosh, editor of *Physics News* and Professor Arun Grover, Guest Editor of the Bhabha Centenary Issue of January 2009 for granting us permission to use some of the reminiscences published there. We thank Mr Ravindra Kumar, managing editor of *the Statesman* for giving us permission to reproduce material from *the Statesman*. We thank Mr N. Ram editor-in-chief of the *Hindu* for enabling us to include significant material from the *Hindu*. We would also like to thank Mr H. R. Mohan and Mr. K. Rajendrababu, Chief Librarian the *Hindu* for their active support and help. We would like to thank the Taj Westend, Bangalore for making accessible archival photographs.

We would like to express a special word of gratitude to Mrs Feroza Seervai for her support and for generously making available the Bhabha-Seervai correspondence. Mr Vijay Thiruvady kindly gave us access to letters written by Dr Bhabha to his grandfather, Professor K.S. Krishnan. We are thankful to Mrs Mila Chakrabarty, Librarian of Cathedral and John Connon Schools for material from the school Archives. We owe a special debt of gratitude to Mr R.M. Lala and Dr Nawaz Modi for their counsel and support. For taking an interest in our project special thanks are due to Mrs Mithoo Coorlawala, Mr Aziz Javeri, Professor Pankaj Joshi, Mrs Hira Steven and Mrs Scylla Vatcha. Dr Hannah Peters was most enthusiastic about our project. It is a matter of great regret for us that she passed away before we completed it. We are grateful to some of the members of Dr Bhabha's extended family – Mrs Scylla Vatcha, Mrs Roshan Rivetna, Ms Rati Cooper and Ms Perin Boga for contributing to our volume. We thank Professor Francis Huxley for his support. We are grateful to Professor Gustav Born, Sir Maurice Wilkes, Professor P.C. Vaidya, Mr N.B. Prasad, Mr Homi Sethna, Dr M.R. Srinivasan, Professor George Sudarshan, Professor S.S Jha, Professor Ramnath Cowsik, Mrs Mrinalini Sarabhai, Mr Jehangir Sabavala, Mr Krishen Khanna, Mr Maqbool Fida Husain, Mr Kekoo Gandhi, Dr Dinesh Daftary and Mr Suresh Sawant for sharing their memories of Dr Bhabha at our request.

Writing this book also offered us the gift of friendship with fellow historians whose scholarship, advice and generosity have been truly overwhelming – we would like to thank Robert S. Anderson, Ross Bassett, Nancy Greenspan, Uma Dasgupta, Ram Guha, D.C.V. Mallik, Atri Mukhopadhyay, Rajinder Singh, Jahnvi Phalkey, Chandak Sengoopta and Amrita Shah. The works of G. Venkataraman, Robert Anderson and Chintamani Deshmukh on Bhabha's life and institution-building and the analysis of his science by Professors B.V. Sreekantan, Virendra Singh and B.M. Udgaonkar in the *Homi Bhabha: Collected Scientific Papers* have been very important for us. We thank Professors M.S. Raghunathan, Sunil Mukhi and K. Sridhar of TIFR for their support. We are indebted to Dr Mikael Smedback and Dr Meera Parish for translating the material we received from the Nobel Archive. Professor Shiraz Minwalla patiently read through the manuscript and offered us constructive guidance. To him our heartfelt thanks. We are also thankful for the friendship and encouragement of Dr Maithreyi Narasimha and Professors Veronica Rodrigues, Alok Ray, Sreerup Raychaudhuri and K. Vijay Raghavan. We thank Bharati Malar Periasamy for tracing several documents at TIFR Archives. Our heartfelt gratitude to Hasmukh Chauhan and everyone at the Photography section of TIFR for scanning and providing many of the photographs reproduced here. We thank Kishore Menon and Mahendra Jadhav of TIFR. For all their help and involvement we would like to thank Aarthi Ajit of Archival Resources for Contemporary History, Ajay Salve of TIFR and Sybil Rodrigues of Trapeze.

We owe a debt of gratitude to R. Sivapriya, commissioning editor of Penguin India for sharing our vision of the book. Collaborating with Sarita Sundar of Trapeze on the design of this book was a delightful experience that unlocked startling insights and brought fresh understanding. To her we are deeply indebted. We thank Archival Resources for Contemporary History Bangalore for defraying design costs.

Indira is thankful to Ashok Dhareshwar for sharing his collection of books on the history of science but more importantly, for his gift of digital equipment with which innumerable oral history interviews were recorded. Ananya is grateful to Achintya and Anindita Dasgupta, Naval and Khadija Minwalla without whose unconditional support and encouragement many things would have remained a dream.

Finally, affectionate appreciation and thanks are due to our respective families – Vivek Dhareshwar and Rohini Sen; Shiraz and Spandan Minwalla – for their support, patience, kindness and good humoured tolerance of what seemed an unending obsession with Homi Bhabha.

Indira Chowdhury and Ananya Dasgupta
Bangalore and Mumbai, March 2010

Homi Bhabha's photographs, letters, paintings and sketches all speak of a man who was truly in tune with his times. A westernized Parsi – Bhabha's taste and style reflected a modernity that was contemporary and European in its essence.

Modernist movements such as the Bauhaus have had a deep impact on the world. Concepts about art and design that were nurtured by the movement travelled to India and sometimes metamorphosed into different forms. We found to our delight, traces of that conceptual language that began in Bauhaus at Bhabha's Institute – not only in the paintings that Bhabha acquired but in the architecture and the landscape. The Tulip Chair, an icon of mid-century modern furniture design that Bhabha had acquired for his office, still stands witness to that trajectory.

The design of this book grew out of an intimate dialogue between the archival material and the history and principles of design as it evolved in the mid twentieth century. A graphic overture that weaves together letters and reminiscences, photos, sketches and diary excerpts, quotes from speeches and articles; here linearity has been sacrificed at times in favour of the unexpected and the coincidental. Modernist principles of economy of expression have been followed in the typographical usage and the bold use of colours – reds, blues and steel greys. These provide a rhythm and a system for the sometimes overwhelming assemblage that illustrates the richness and diversity of talents of this 'scientist humanist'.

Sarita Sundar, Trapeze

Indira Chowdhury, Archival Resources for Contemporary History

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Ananya Dasgupta began her career with the *Telegraph*, Kolkata, and has extensive experience as a journalist. She has been working as an editor with the Tata Institute of Fundamental Research Archives for the last three years. In 2009, she was involved in conceptualizing the Bhabha Centenary permanent exhibition *The Visionary and the Vision* at TIFR, Mumbai. She is currently responsible for the TIFR Oral History Project.